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### (54) CHEWING GUM COMPRISING AT LEAST TWO DIFFERENT BIODEGRADABLE POLYMERS

KAUGUMMI DER MINDESTENS ZWEI VERSCHIEDENE BIOLOGISCHABBAUBARE POLYMEREN  
ENTHALT

GOMME A MACHER RENFERMANT AU MOINS DEUX DIFFERENTS POLYMERES  
BIODEGRADABLES

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**Description****Field of the invention**

5 [0001] The invention relates to a chewing gum comprising at least two different biodegradable polyester polymers.

**Background of the Invention**

[0002] Softeners are small-molecular structures typically applied for the purpose of modifying the texture of the elastomer applied in the chewing gum. A problem when applying softeners to biodegradable polymers is that too extensive use may result in dissolving the polymer before the desired texture is reached.

[0003] It is the object of the invention to provide a chewing gum having certain desired texture without dissolving the overall chewing gum structure when adjusting the texture.

15 [0004] It is a further object of the invention to obtain a completely biodegradable chewing gum having a texture comparable to conventional chewing gum.

[0005] According to the prior art, a great significance has been made out of glass transition temperature of chewing gum. Especially, when dealing with biodegradable chewing gum.

20 [0006] The glass transition temperature  $T_g$  can loosely be defined as the temperature where a polymer undergoes a significant change in properties. The  $T_g$  is where a polymer structure turns "rubbery" upon heating and "glassy" upon cooling.  $T_g$  is regarded as a so-called second order transition, i.e. a thermal transition that involves a change in heat capacity, but does not have a latent heat.

25 [0007] According to the prior art within the field of chewing gum, e.g. as disclosed in WO 00/19837 and US 5 672 367 great efforts have been made in obtaining a glass transition temperature of the applied chewing gum below about 37 °C. In other words, the user of a chewing gum should be able to change the conditions of a chewing gum from below the glass transition temperature to above the glass transition temperature, when the chewing gum is chewed and in fact heated in the mouth.

30 [0008] On the other hand, as it generally applies to chewing gum and e.g. disclosed in US 5,623,098, the glass transition temperature of the chewing gum should not lay significantly below reasonably expected storage temperature, e.g. 10 degrees to 12 degrees C. For this reason a significant effort has been made in order to counteract the expected increase to prevent blocking. Such shipping and storage temperatures are stated to be non-cost-effective. In fact such temperatures may not be possible when shipping in, or to, certain locations. Thus, it is stated in US 5,623,098 that cold flow causes independent base pellets or slabs to join or fuse together so that individual slabs or pellets cannot be removed from their container or carton. Pelletized or slab-poured gum base that is stored or shipped at temperatures above its glass transition temperature can deform. Subjected to gravitational forces, these slabs or pellets agglomerate or mass together with other pellets or slabs.

35 [0009] This requirement is reflected in both WO 00/19837 and US 5,672,367 where a biodegradable chewing gum is disclosed comprising one single polymer having a relatively high glass temperature.

40 [0010] However, a drawback of the prior art biodegradable chewing gum is that the biodegradable elastomer polymers by nature perform somewhat different than conventional elastomers. According to the prior art, these deviating properties have dealt with by focussing strictly on keeping the glass transition temperature of the resulting chewing gum below or about 37°C whereby the desired properties would be obtained.

[0011] However, a drawback of the above-described chewing gums is that the final obtainable texture may differ from that of conventional chewing gum.

45 [0012] WO 00/35297 discloses a gum base, which includes one degradable polymer alone or in combination with non-biodegradable polymers. Further EP 0 711 506 discloses a chewing gum comprising one biodegradable polymer.

[0013] WO 02 076 227 deals with a coated chewing gum element comprising a chewing gum centre comprising at least one environmentally degradable elastomeric or resinous polymer and an outer coating.

[0014] WO 02 076 229 deals with a process for preparing a chewing gum, where the gum base does not contain a vinyl polyester as the sole functional chewing gum polymer.

50 [0015] WO 02 076 230 deals with an elastomer for chewing gum comprising a polyester polymer obtainable by the polymerisation of two or more different cyclic ester monomers.

[0016] It is an object of the invention to obtain a biodegradable chewing gum having a texture comparable to conventional chewing gum.

55 [0017] It is an object of the invention to provide both a biodegradable chewing gum that may actually be shipped and distributed under normal or at least substantially conventional chewing gum distribution parameters and on the other hand exhibit an acceptable texture, when applied as a chewing gum.

## Summary of the Invention

[0018] The invention relates to a chewing gum comprising at least two different biodegradable polymers wherein at least two of said biodegradable polymers comprise a polyester polymer,  
 5 wherein at least one of said at least two different biodegradable polymers comprises at least one biodegradable elastomer and at least one of said at least two different biodegradable polymers comprises at least one biodegradable elastomer plasticizer, said biodegradable plasticizer comprising at least one biodegradable polymer.

[0019] According to the invention, a chewing gum comprising at least two different biodegradable polymers exhibits an improved texture prior to any adding of for example softeners. It has been realized that the desired chewing gum texture properties, contrary to every expectation and any prior art disclosures, may actually be obtained when combining biodegradable chewing gum polymers, for example in the gum base or in the final gum.

[0020] The fact that biodegradable polymers may actually be configured into a suitable polymer gum base, e.g. at least one biodegradable elastomer and at least one biodegradable synthetic resin substitute, facilitate the possibility of providing a completely biodegradable chewing gum.

[0021] According to an embodiment of the invention, a chewing gum should preferably comprise different biodegradable polymers in order to enable a uniform or a certain desired release profile over time.

[0022] According to an embodiment of the invention, it has been realized that chewing gum made on the basis of biodegradable polymers features an improved release of flavors, active ingredients or for example sweeteners when compared to release in chewing gums made on a conventional basis. Specifically, it has been established that different biodegradable polymers typically result in very different release properties during the complete chewing phase when compared to conventional chewing gum

[0023] Moreover, according to the invention, it has been established that the different release profiles may in fact be sort of super positioned in order to obtain a desired release profile.

[0024] According to a preferred embodiment of the invention it has been realized that it is in fact possible to pair a biodegradable polymer plasticizer with an elastomer without compromising the desire for non-tack. Moreover, it has been realized that improved texture may be obtained by incorporation of biodegradable plasticizers in a chewing gum or the gum base.

[0025] Further significant chewing gum characteristics may also be improved compared to conventional biodegradable single or dual elastomer system.

[0026] A group of elastomer plasticizers is often functionally referred to as synthetic or natural resins within the art. Therefore, according to the terminology applied for the purpose of describing the invention, the term resin may refer broadly to the elastomer plasticizing function, unless specific reference to named resin types are mentioned.

[0027] In an embodiment of the invention, at least one of said at least two different biodegradable polymers comprises a polyester produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof.

[0028] According to a preferred embodiment of the invention, at least one of the polymers is produced through reaction of at least one alcohol and at least one acid. This type of polymer features advantageous properties when applied in chewing gum or gum base, both with respect to processing and the finally obtained texture.

[0029] In an embodiment of the invention, said alcohol derivative comprises an ester of an alcohol.

[0030] For the purpose of illustration and not limitation some examples of alcohol derivatives include triacetin, glycerol palmitate, glycerol sebacate, glycerol adipate, tripropionin, etc. Typically, derivatives of polyols are preferred although e.g. end capping may be applied by the use of monohydroxy alcohols.

[0031] In an embodiment of the invention, said acid derivative comprises esters, anhydrides or halides of carboxylic acids.

[0032] Polycondensations involving transesterification of the ester of a polyfunctional acid is often the preferred process. For example, the dimethyl ester of terephthalic acid might be used instead of terephthalic acid itself. In this case, methanol rather than water is condensed, and the former can be driven off more easily than water.

[0033] In an embodiment of the invention, said acid derivative comprises methyl esters of acids.

[0034] In an embodiment of the invention, said alcohol or derivatives thereof comprise polyols.

[0035] One of several features of applying polyols, i.e. multifunctional alcohols is to facilitate branching of the monomer chains.

[0036] In an embodiment of the invention, said acids or derivatives thereof comprise polyfunctional carboxylic acids.

[0037] In an embodiment of the invention, said at least one biodegradable polymer produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof has a PD of 1.1 to 20, preferably 1.3 to 12.

[0038] According to a preferred embodiment of the invention, PD is ranging relatively high, especially when dealing with elastomers where a high degree of elasticity is desired. PD refers to polydispersity. In this context it is noted that PD may be adjusted when taking the molecular weight into consideration. A relatively low molecular weight Mn of a polymer may be compensated for by a relatively high PD or vice versa.

[0039] In an embodiment of the invention, at least one of said at least two different biodegradable polymers comprises a polyester obtained by polymerization of at least one cyclic ester.

[0040] According to a preferred embodiment of the invention, the polyester obtained by polymerization of at least one cyclic ester comprises no or few aromatic groups as the polymerization typically involves ring opening. Thus, such a polymer is typically aliphatic, thereby featuring easy hydrolytic bonds and thereby high degree of biodegradability.

5 [0041] In an embodiment of the invention, said polyester obtained by polymerization of at least one cyclic ester is at least partly derived from  $\alpha$ -hydroxy acids such as lactic and glycolic acids.

[0042] According to an embodiment of the invention at least one of the applied polyester polymers are derived from  $\alpha$ -hydroxy acids such as lactic and glycolic acids. The obtained ester linkages, due to their chemical structure, are very susceptible to hydrolysis, and because these acids are natural metabolites, their esters are susceptible to a large variety of enzymatic degradation mechanisms, by the human body, animal bodies and bacteria.

[0043] In an embodiment of the invention, said polyester obtained by polymerization of at least one cyclic ester is at least partly derived from  $\alpha$ -hydroxy acids and where the obtained polyester comprises at least 20 mole%  $\alpha$ -hydroxy acids units, preferably at least 50 mole%  $\alpha$ -hydroxy acids units and most preferably at least 80 mole%  $\alpha$ -hydroxy acids units

15 [0044] According to a preferred embodiment of the invention, the chewing gum comprises an elastomer plasticizer comprising more than 90 mole%  $\alpha$ -hydroxy acids, e.g. lactic acid units.

[0045] In an embodiment of the invention, at least two or more cyclic esters are selected from the groups of glycolides, 20 lactides, lactones, cyclic carbonates or mixtures thereof.

[0046] In an embodiment of the invention, lactone monomers are chosen from the group of  $\epsilon$ -caprolactone,  $\delta$ -valerolactone,  $\gamma$ -butyrolactone, and  $\beta$ -propiolactone. It also includes  $\epsilon$ -caprolactones,  $\delta$ -valerolactones,  $\gamma$ -butyrolactones, or  $\beta$ -propiolactones that have been substituted with one or more alkyl or aryl substituents at any non-carbonyl carbon atoms along the ring, including compounds in which two substituents are contained on the same carbon atom.

[0047] In an embodiment of the invention, carbonate monomer is selected from the group of trimethylene carbonate, 5-alkyl-1,3-dioxan-2-one, 5,5-dialkyl-1,3-dioxan-2-one, or 5-alkyl-5-alkyloxycarbonyl-1,3-dioxan-2-one, ethylene carbonate, 3-ethyl-3-hydroxymethyl, propylene carbonate, trimethylolpropane monocarbonate, 4, 6dimethyl-1,3-propylene carbonate, 2, 2-dimethyl trimethylene carbonate, and 1, 3-dioxepan-2-one and mixtures thereof.

[0048] In an embodiment of the invention, cyclic ester polymers and their copolymers resulting from the polymerization of cyclic ester monomers include, but are not limited to: poly (L-lactide) ; poly (D-lactide) ; poly (D, L-lactide) ; poly (mesolactide) ; poly (glycolide) ; poly (trimethylene carbonate) ; poly (epsilon-caprolactone) ; poly (L-lactide-co-D, L-lactide) ; poly (L-lactide-co-meso-lactide) ; poly (L-lactide-co-glycolide) ; poly (L-lactide-co-trimethylene carbonate) ; poly (L-lactide-co-epsilon-caprolactone) ; poly (D, L-lactide-co-meso-lactide) ; poly (D, L-lactide-co-epsilon-caprolactone) ; poly (meso-lactide-co-glycolide) ; poly (meso-lactide-co-trimethylene carbonate) ; poly (meso-lactide-co-epsilon-caprolactone) ; poly (glycolide-co-crotonyl) ; poly (glycolide-co-epsilon-caprolactone).

[0049] In an embodiment of the invention, said polyester obtained by polymerization of at least one cyclic ester has a PD of 1.1 to 15, preferably 1.3 to 9.

[0050] According to a preferred embodiment of the invention, PD is ranging relatively high, especially when dealing with elastomers, where a high degree of elasticity is desired. In this context it is noted that PD may be adjusted when taking the molecular weight into consideration. A relatively low molecular weight Mn of a polymer may be compensated for by a relatively high PD or vice versa.

[0051] In an embodiment of the invention, at least one of said biodegradable elastomers comprises said polyester produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof.

[0052] According to an embodiment of the invention, polyester produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof inherits advantageous release with respect to long-term release of chewing gum ingredients, e.g. flavoring, etc.

[0053] In an embodiment of the invention, said elastomer is produced through reaction of at least one acid chosen from terephthalic, phthalic, adipic, pimelic acids or combinations thereof with at least one alcohol chosen from the groups of diethylene and 1,4-butylen diols or combinations thereof.

[0054] In an embodiment of the invention, said at least one biodegradable elastomer produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof has a molecular weight of 10000-250000 g/mol (Mn), preferably 20000-150000 g/mol (Mn).

[0055] In an embodiment of the invention, at least one of said biodegradable elastomer plasticizers comprises said polyester produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof.

[0056] In an embodiment of the invention, said resin is produced through reaction of at least one acid chosen from terephthalic, succinic, malonic and adipic acids or combinations thereof with at least one alcohol chosen from ethylene, diethylene or 1,4-butylen diols and combinations thereof.

[0057] In an embodiment of the invention, said at least one biodegradable elastomer plasticizer produced through

reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof has a molecular weight of 500-19000 g/mol (Mn), preferably 1500-9000 g/mol (Mn).

[0058] In an embodiment of the invention, at least one of said biodegradable elastomers comprises said polyester obtained by polymerization of at least one cyclic ester.

5 [0059] In an embodiment of the invention, the molecular weight of said biodegradable elastomer is within the range of 10000 - 10000000 g/mol Mn, preferably within the range of 30000 - 2500000 g/mol Mn.

[0060] In an embodiment of the invention, at least one of said biodegradable elastomer plasticizers comprises said polyester obtained by polymerization of at least one cyclic ester.

10 [0061] In an embodiment of the invention, said chewing gum comprises at least one elastomer plasticizer comprising at least one of said polyesters obtained by polymerization of at least one cyclic ester and at least one elastomer comprising at least one of said polyesters produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof.

15 [0062] An advantage of mixing the two types of polymers together is that the high degree of degradability offered by the biodegradable polymers applied as elastomer plasticizers may be combined with advantageous properties of the biodegradable elastomer with respect to robustness with respect to added softeners, etc., texture, release and process-ability.

[0063] In an embodiment of the invention, the at least two different polymers are hydrophilic.

20 [0064] It should be noted that the degree of hydrophilic behavior of the polymer might vary quite significantly from polymer to polymer. It is, however, a general fact that the biodegradable polymers are more hydrophilic than conventional polymers.

[0065] Typical biodegradable polymers are relatively hydrophilic.

25 [0066] In an embodiment of the invention, the difference in molecular weight between the at least two different polymers is at least 1000 g/mol Mn.

[0067] According to an advantageous embodiment of the invention, the molecular weight of the applied different polymers should differ to a certain degree, preferably at least 1000 g/mol Mn in order to obtain the desired texture properties. Apparently, the plasticizing effect of the plasticizing polymer(s) on the polymer(s) to be plasticized decreases if the molecular weight becomes too equal.

30 [0068] When applying relatively significant differences in molecular weight between the applied biodegradable polymers, an increased possibility of tuning with respect to both texture and for instance chewing gum release has been obtained.

[0069] According to the prior art, attempts have been made within the field of biodegradable chewing gum to provide a chewing gum having texture properties comparable to the texture properties of conventional chewing gum. According to e.g. US 6,153,231, it has been realized that chewing gum made on the basis of biodegradable elastomers should preferably be made on the basis of an elastomer, thereby eliminating the annoying tackiness established by conventional plasticizers. According to an embodiment of the invention, the desired texture of biodegradable chewing gum may be obtained by the plasticizing of a biodegradable polyester plasticizer on a biodegradable polyester elastomer in an advantageous way if the properties of the polyesters are substantially maintained with respect to certain properties even after mixing the final gum base or chewing gum. This aspect is according to an embodiment of the invention particular of interest with respect to Tg. It has thus been established that the Tg's of the individual polyester may be maintained even in a multicomponent system, thereby offering a multiple polymer system comprising a desired multi-functionality with respect to cold-floating properties. Thus, when mixing for example two different polyesters into a gum base or chewing gum, Tg's of both polymers have been found to be substantially unchanged.

[0070] In an embodiment of the invention, the difference in molecular weight between the at least two different polymers is at least 20000 g/mol Mn or at least 50000 g/mol Mn.

45 [0071] In an embodiment of the invention, the molecular weight of said biodegradable plasticizer is in the range of 500 - 19000 g/mol, preferably within the range of 1500 - 9000 g/mol Mn.

[0072] In an embodiment of the invention, said at least two different biodegradable polymers have a different glass transition temperature Tg.

50 [0073] According to an embodiment of the invention, it has been realized that biodegradable chewing gum having a texture comparable to conventional chewing gum may be obtained, when at least two of the applied biodegradable polymers have different glass transition temperatures. In other words, the applied biodegradable polymers form a hybrid polymer gum base or chewing gum having at least two different properties with respect to the glass transition temperature.

[0074] According to an embodiment of the invention, at least one of the applied biodegradable polymers may be applied for countering cold floating of the gum base or the final chewing gum and at least one of the other polymers may be applied for obtaining desired chewing gum properties with respect to texture.

55 [0075] In other words, according to the invention, it has been realized that the expected requirements with respect to the applied biodegradable polymers of a chewing gum may be significantly loosened when applying more polymers according to the invention.

[0076] Hence, according to an embodiment of the invention, the important issue of facilitating shipping of the final product with respect to cold floating may even, and unexpectedly, be dealt with by means of at least one stabilizing biodegradable polymers, e.g. a biodegradable polymer having a relatively high glass transition temperature mixed with a further biodegradable polymer featuring another glass temperature than the stabilizing polymers. Typically, the at least one further biodegradable polymer may be chosen by e.g. an elastomer having a relatively low glass transition temperature.

[0077] Moreover, according to an embodiment of the invention, it has been realized that biodegradable polymers, when incorporated in a gum base or chewing gum composition, react somewhat vulnerable compared to conventional polymers and it has moreover been realized that this vulnerability to softeners may be compensated for when applying texture improving mixtures of at least two polymers having different glass transition temperatures. Hence, the need for structure weakening softeners may be reduced due to the fact, that the texture is improved when compared to single Tg polymer blends of chewing gum.

[0078] In an embodiment of the invention said at least two different biodegradable polymers having a different glass transition temperature Tg.

[0079] According to the invention, at least one of the applied biodegradable polymers may be applied for counteracting cold floating of the gum base or the final chewing gum and at least one of the other may be applied for obtaining the desired chewing gum properties with respect to texture.

[0080] The one applied for the purpose of counteracting floating should preferably be relatively high, whereas the other, providing the advantageous texture, should preferably be relatively low, typically substantially lower than room temperature.

[0081] According to the invention, it has been realized that the desired texture properties may be obtained when the mixed chewing gum elastomer and elastomer solvents comprise at least two different Tg's.

[0082] In an embodiment of the invention, at least one of the applied biodegradable polymers, preferably a plasticizer has a glass transition of at least +1 °C, preferably at least +10°C and more preferably at least +20°C.

[0083] In an embodiment of the invention, at least one of the at least two different biodegradable polymers has a glass transition temperature of less than 0°C, preferably less than -30°C and more preferably less than -50°C.

[0084] In an embodiment of the invention, the resulting chewing gum has at least two different glass transition temperatures Tg.

[0085] According to an advantageous embodiment of the invention, a gum base or a chewing gum prepared according to the invention has at least two different glass transition temperatures, thereby featuring a polymer system comprising at least two different biodegradable polymers which are not completely mixed by complete dissolving but rather featuring a mix of polymers having properties of both the at least two polymers. Thereby, advantageous properties of the resulting chewing gum have been obtained, especially with respect to texture.

[0086] In an embodiment of the invention, the chewing gum comprises at least one biodegradable elastomer having a glass transition temperature Tg below 0°C and at least one biodegradable plasticizer having a glass transition temperature Tg exceeding 0°C.

[0087] In an embodiment of the invention, said chewing gum comprises at least one biodegradable elastomer in the amount of about 0.5 to about 70% by weight of the chewing gum, at least one biodegradable plasticizer in the amount of about 0.5 to about 70% by weight of the chewing gum and at least one chewing gum ingredient chosen from the groups of softeners, sweeteners, flavoring agents, active ingredients and fillers in the amount of about 2 to about 80% by weight of the chewing gum.

[0088] In an embodiment of the invention, all the biodegradable polymers comprised in the chewing gum comprise at least 25%, preferably at least 50% of the chewing gum polymers.

[0089] In an embodiment of the invention, all the biodegradable polymers comprised in the chewing gum comprise at least 80%, preferably at least 90% of the chewing gum polymers.

[0090] In an embodiment of the invention, the chewing gum is substantially free of non-biodegradable polymers.

[0091] Preferably, the chewing gum is free of non-biodegradable polymers.

[0092] In an embodiment of the invention, said chewing gum ingredients comprise flavoring agents.

[0093] In an embodiment of the invention, said chewing gum comprises flavor in the amount of 0.01 to about 30 % by weight, said percentage being based on the total weight of the chewing gum, preferably 0.2 to about 4 % by weight, said percentage being based on the total weight of the chewing gum.

[0094] In an embodiment of the invention, said chewing gum ingredients comprise sweeteners.

[0095] In an embodiment of the invention, the chewing gum comprises bulk sweeteners in the amount of about 5 to about 95% by weight of the chewing gum, more typically about 20 to about 80% by weight of the chewing gum.

[0096] In an embodiment of the invention, the chewing gum comprises high intensity sweeteners in the amount of about 0 to about 3% by weight of the chewing gum, more typically about 0.05 to about 0.5% by weight of the chewing gum.

[0097] In an embodiment of the invention, the chewing gum comprises at least one softener in the amount of about 0 to about 18% by weight of the chewing gum, more typically about 0 to about 12% by weight of the chewing gum.

- [0098] In an embodiment of the invention, said chewing gum ingredients comprise active ingredients.
- [0099] In an embodiment of the invention, the chewing gum comprises filler in an amount of about 0 to about 50% by weight of the chewing gum, preferably about 10 to about 40% by weight of the chewing gum.
- [0100] In an embodiment of the invention, the chewing gum comprises at least one coloring agent.
- 5 [0101] In an embodiment of the invention, the chewing gum is coated with an outer coating.
- [0102] According to an embodiment of the invention, said chewing gum comprises conventional chewing gum polymers and/or elastomer plasticizer.
- [0103] According to an embodiment of the invention, the at least one biodegradable polymer comprises at least 5% of the chewing gum polymers.

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#### Drawings

- [0104] The invention will now be described with reference to the drawings of which

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- fig. 1 and 2 illustrate rheological properties of chewing gum according to the invention
- fig. 3 to 5 illustrate sensory texture profile of the chewing gum according to the invention and
- fig. 6 and 7 illustrate stress sweep and frequency sweep of different gum bases made according to the invention.

#### Detailed description

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- [0105] Unless otherwise indicated, as used herein, the term "molecular weight" means number average molecular weight (Mn). The short form PD designates the polydispersity.

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- [0106] The glass transition temperature may be determined by for example DSC (DSC: differential scanning calorimetry). The DSC may generally be applied for determining and studying of the thermal transitions of a polymer and specifically, the technique may be applied for the determination of a second order transition of a material, i.e. a thermal transition that involves a change in heat capacity, but does not have a latent heat. The glass transition is a second-order transition.

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- [0107] Generally, in the following examples of the detailed description two different types of polymers may be referred to as polyester type 1 and polyester type 2. The polyester type 1 generally refers to a polyester produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof. Further specification of this type of polyester polymers is given in the specification and claims. The polyester type 2 generally refers to a polyester polymer obtained by polymerization of at least one cyclic ester. Further specification of this type of polyester polymers is given in the specification and claims.

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- [0108] In the present context, the terms environmentally or biologically degradable polymer compounds refer to chewing gum base components which, after dumping the chewing gum, are capable of undergoing a physical, chemical and/or biological degradation whereby the dumped chewing gum waste becomes more readily removable from the site of dumping or is eventually disintegrated to lumps or particles which are no longer recognizable as being chewing gum remnants. The degradation or disintegration of such degradable polymers can be effected or induced by physical factors such as temperature, light, moisture, by chemical factors such as hydrolysis caused by a change in pH or by the action of enzymes capable of degrading the polymers. In other useful embodiments all of the polymer components of the gum base are environmentally degradable or biodegradable polymers.

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- [0109] Preferably, the ultimate degradation products are carbon dioxide, methane and water.

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- [0110] According to a preferred definition of biodegradability according to the invention, biodegradability is a property of certain organic molecules whereby, when exposed to the natural environment or placed within a living organism, they react through an enzymatic or microbial process, often in combination with a pure chemical process such as hydrolysis, to form simpler compounds, and ultimately, carbon dioxide, nitrogen oxides, methane and water.

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- [0111] Accordingly, suitable examples of additional environmentally or biologically degradable chewing gum base polymers, which can be applied in accordance with the gum base of the present invention, include degradable polyesters, poly(ester-carbonates), polycarbonates, polyester amides, polypeptides, homopolymers of amino acids such as polylysine, and proteins including derivatives thereof such as e.g. protein hydrolysates including a zein hydrolysate. Particularly useful compounds of this type include polyester polymers obtained by the polymerisation of one or more cyclic esters such as lactide, glycolide, trimethylene carbonate,  $\delta$ -valerolactone,  $\beta$ -propiolactone and  $\epsilon$ -caprolactone, and polyesters obtained by polycondensation of a mixture of open-chain polyacids and polyols, for example, adipic acid and di(ethylene glycol). Hydroxy carboxylic acids such as 6-hydroxyhexanoic acid may also be used to form polyesters or they may be used in conjunction with mixtures of polyacids and polyols. Such degradable polymers may be homopolymers, copolymers or terpolymers, including graft- and block-polymers.

**EXAMPLE 1****Preparation of polyester type 2 resin**

5 [0112] A resin sample is produced using a cylindrical glass, jacketed 10 L pilot reactor equipped with glass stir shaft and Teflon stir blades and bottom outlet. Heating of the reactor contents is accomplished by circulation of silicone oil, thermo stated to 130°C, through the outer jacket.  $\epsilon$ -caprolactone (358.87 g, 3.145 mol) and 1,2-propylene glycol (79.87 g, 1.050 mol) are charged to the reactor together with stannous octoate (1.79 g,  $4.42 \times 10^{-3}$  mol) as the catalyst and reacting in about 30 min, at 130°C. Then molten D,L-lactide (4.877 kg, 33.84 mol) are added and reaction continued for 10 about 2 hours. At the end of this period, the bottom outlet is opened, and molten polymer is allowed to drain into a Teflon-lined paint can. Characterization of the product indicates  $M_n = 6,000$  g/mol and  $M_w = 7,000$  g/mol (gel permeation chromatography with online MALLS detector) and  $T_g = 25-30^\circ\text{C}$  (DSC, heating rate 10°C/min).

**EXAMPLE 2**

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**Preparation of polyester type 1 resin**

20 [0113] A resin (elastomer solvent) sample is produced using a 500 mL resin kettle equipped with an overhead stirrer, nitrogen gas inlet tube, thermometer, and distillation head for removal of methanol. To the kettle are charged 126.22 g (0.65 mole) dimethyl terephthalate, 51.15 g (0.35 mole) dimethyl succinate, 64.27 g (1.036 mole) ethylene glycol and 0.6 g calcium acetate monohydrate. Under nitrogen, the mixture is slowly heated with stirring until all components become molten (120-140°C). Heating and stirring are continued and methanol is continuously distilled. The temperature slowly rises in the range 150-200°C until the evolution of methanol ceases. Heating is discontinued and the content is allowed to cool to about 100°C. The reactor lid is removed and the molten polymer carefully poured into a receiving vessel.

25 [0114] Characterization of the product indicates  $M_n = 5,000$  g/mol and  $M_w = 10,000$  g/mol (gel permeation chromatography with online MALLS detector) and  $T_g = 30^\circ\text{C}$  (DSC, heating rate 10°C/min).

**EXAMPLE 3**

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**Preparation of polyester type 2 elastomer**

35 [0115] An elastomer sample is synthesized within a dry  $\text{N}_2$  glove box, as follows. Into a 500 mL resin kettle equipped with overhead mechanical stirrer, 0.73 g 1,2-propane diol (3.3mL of a 22.0%(w/v) solution in methylene chloride) and 0.152 g  $\text{Sn}(\text{Oct})_2$  (3.56 mL of a 4.27%(w/v) solution in methylene chloride) are charged under dry  $\text{N}_2$  gas purge. The methylene chloride is allowed to evaporate under the  $\text{N}_2$  purge for 15 min. Then  $\epsilon$ -caprolactone (300g, 2.63 mol) and  $\delta$ -valerolactone (215g, 2.15 mol) are added. The resin kettle is submerged in a 130°C constant temperature oil bath and stirred for 14 h. Subsequently the kettle is removed from the oil bath and allowed to cool at room temperature. The solid, elastic product is removed in small pieces using a knife, and placed into a plastic container. Characterization of the product indicates  $M_n = 60,000$  g/mol and  $M_w = 90,000$  g/mol (gel permeation chromatography with online MALLS detector) and  $T_g = -70^\circ\text{C}$  (DSC, heating rate 10°C/min).

**EXAMPLE 4****Preparation of polyester type 1 elastomer**

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[0116] An elastomer sample is produced using a 500 mL resin kettle equipped with an overhead stirrer, nitrogen gas inlet tube, thermometer, and distillation head for removal of methanol. To the kettle are charged 83.50 g (0.43 mole) dimethyl terephthalate, 99.29 g (0.57 mole) dimethyl adipate, 106.60 g (1.005 mole) di(ethylene glycol) and 0.6 g calcium acetate monohydrate. Under nitrogen, the mixture is slowly heated with stirring until all components become molten (120-140°C). Heating and stirring are continued and methanol is continuously distilled. The temperature slowly rises in the range 150-200°C until the evolution of methanol ceases. Heating is discontinued and the content is allowed to cool to about 100°C.

[0117] The reactor lid is removed and the molten polymer is carefully poured into a receiving vessel. Characterization of the product indicates  $M_n = 40,000$  g/mol and  $M_w = 190,000$  g/mol (gel permeation chromatography with online MALLS detector) and  $T_g = -30^\circ\text{C}$  (DSC, heating rate 10°C/min).

55 [0118] Referring to the examples 2 and 4 regarding polyester type 1, polymers of this type may generally within the scope of the Invention be prepared by step-growth polymerization of di-, tri- or higher-functional alcohols or esters thereof with di-, tri- or higher-functional aliphatic or aromatic carboxylic acids or esters thereof. Likewise, also hydroxy acids or

anhydrides and halides of polyfunctional carboxylic acids may be used as monomers. The polymerization may involve direct polyesterification or transesterification and may be catalyzed. Use of branched monomers suppresses the crystallinity of the polyester polymers. Mixing of dissimilar monomer units along the chain also suppresses crystallinity. To control the reaction and the molecular weight of the resulting polymer it is possible to stop the polymer chains by addition of monofunctional alcohols or acids and/or to utilize a stoichiometric imbalance between acid groups and alcohol groups or derivatives of either. Also the adding of long chain aliphatic carboxylic acids or aromatic monocarboxylic acids may be used to control the degree of branching in the polymer and conversely multifunctional monomers are sometimes used to create branching. Moreover, following the polymerization monofunctional compounds may be used to end cap the free hydroxyl and carboxyl groups.

[0119] In general, polyfunctional carboxylic acids are high-melting solids that have very limited solubility in the polycondensation reaction medium. Often esters or anhydrides of the polyfunctional carboxylic acids are used to overcome this limitation. Polycondensations involving carboxylic acids or anhydrides produce water as the condensate, which requires high temperatures to be driven off. Thus, polycondensations involving transesterification of the ester of a polyfunctional acid are often the preferred process. For example, the dimethyl ester of terephthalic acid may be used instead of terephthalic acid itself. In this case, methanol rather than water is condensed, and the former can be driven off more easily than water. Usually, the reaction is carried out in the bulk (no solvent) and high temperatures and vacuum are used to remove the by-product and drive the reaction to completion. In addition to an ester or anhydride, a halide of the carboxylic acid may also be used under certain circumstances.

[0120] Usually, for preparation of polyesters type 1 the preferred polyfunctional carboxylic acids or derivatives thereof are either saturated or unsaturated aliphatic or aromatic and contain 2 to 100 carbon atoms and more preferably 4 to 18 carbon atoms. In the polymerization of polyester type 1 some applicable examples of carboxylic acids, which may be employed as such or as derivatives thereof, includes aliphatic polyfunctional carboxylic acids such as oxalic, malonic, citric, succinic, malic, tartaric, fumaric, maleic, glutaric, glutamic, adipic, glucaric, pimelic, suberic, azelalic, sebacic, dodecanedioic acid, etc. and cyclic aliphatic polyfunctional carboxylic acids such as cyclopropane dicarboxylic acid, cyclobutane dicarboxylic acid, cyclohexane dicarboxylic acid, etc. and aromatic polyfunctional carboxylic acids such as terephthalic, isophthalic, phthalic, trimellitic, pyromellitic and naphthalene 1,4-, 2,3-, 2,6-dicarboxylic acids and the like. For the purpose of illustration and not limitation, some examples of carboxylic acid derivatives include hydroxy acids such as 3-hydroxy propanoic acid and 6-hydroxycaproic acid and anhydrides, halides or esters of acids, for example dimethyl or diethyl esters, corresponding to the already mentioned acids, which means esters such as dimethyl or diethyl oxalate, malonate, succinate, fumarate, maleate, glutarate, adipate, pimelate, suberate, azelate, sebacate, dodecanoate, terephthalate, isophthalate, phthalate, etc. Generally speaking, methyl esters are sometimes more preferred than ethyl esters due to the fact that higher boiling alcohols are more difficult to remove than lower boiling alcohols.

[0121] Furthermore, the usually preferred polyfunctional alcohols contain 2 to 100 carbon atoms as for instance polyglycols and polyglycerols. In the polymerization process of polyester type 1 some applicable examples of alcohols, which may be employed as such or as derivatives thereof, includes polyols such as ethylene glycol, 1,2-propanediol, 1,3-propanediol, 1,3-butanediol, 1,4-butanediol, 1,6-hexanediol, diethylene glycol, 1,4-cyclohexanediol, 1,4-cyclohexanediolmethanol, neopentyl glycol, glycerol, trimethylolpropane, pentaerythritol, sorbitol, mannitol, etc. For the purpose of illustration and not limitation, some examples of alcohol derivatives include triacetin, glycerol palmitate, glycerol sebacate, glycerol adipate, tripropionin, etc.

[0122] Additionally, with regard to polyester type 1 polymerization the chain-stoppers sometimes used are monofunctional compounds. They are preferably either monohydroxy alcohols containing 1-20 carbon atoms or monocarboxylic acids containing 2-26 carbon atoms. General examples are medium or long-chain fatty alcohols or acids, and specific examples include monohydroxy alcohols such as methanol, ethanol, butanol, hexanol, octanol, etc. and lauryl alcohol, myristyl alcohol, cetyl alcohol, stearyl alcohol, stearic alcohol, etc. and monocarboxylic acids such as acetic, lauric, myristic, palmitic, stearic, arachidic, cerotic, dodecrylic, palmitoleic, oleic, linoleic, linolenic, erucic, benzoic, naphthoic acids and substituted naphthoic acids, 1-methyl-2 naphthoic acid and 2-isopropyl-1-naphthoic acid, etc.

[0123] Typically, an acid catalyst or a transesterification catalyst is used in the polyester type 1 polymerization and non-limiting examples of those are the metal catalysts such as acetates of manganese, zinc, calcium, cobalt or magnesium, and antimony(III)oxide, germanium oxide or halide and tetraalkoxygermanium, titanium alkoxide, zinc or aluminum salts.

[0124] Referring to the examples 1 and 3 regarding polyester type 2, polymers of this type may generally be obtained by ring-opening polymerization of one or more cyclic esters, which includes glycolides, lactides, lactones and carbonates. The polymerization process may take place in the presence of at least one appropriate catalyst such as metal catalysts, of which stannous octoate is a non-limiting example and the polymerization process may be initiated by initiators such as polyols, polyamines or other molecules with multiple hydroxyl or other reactive groups and mixtures thereof.

**EXAMPLE 5****Preparation of gum bases**

5 [0125] All the gum bases are prepared with the following basic formulation:

Table 1 gum base preparation

No	Type	Elastomer	Resin	Ratio of elastomer/resin
10	201 bio base	Elastomer polymer from example 3	Resin polymer from example 1	50/50
202 bio base	Elastomer polymer from example 4	Resin polymer from example 2	50/50	
203 bio base	Elastomer polymer from example 4	Resin polymer from example 1	5/95	
204 bio base	Elastomer polymer from example 4	Resin polymer from example 1	10/90	
15	205 bio base	Elastomer polymer from example 4	Resin polymer from example 1	25/75
206 bio base	Elastomer polymer from example 4	Resin polymer from example 1	40/60	
207 bio base	Elastomer polymer from example 4	Resin polymer from example 1	50/50	
208 bio base	Elastomer polymer from example 4	Resin polymer from example 1	60/40	
209 Bio base	Elastomer polymer from example 4	Resin polymer from example 1	80/20	
210 Bio base	Elastomer polymer from example 4	Resin polymer from example 1	95/5	

25 [0126] The gum bases are prepared as follows:

The elastomer and resin are added to a mixing kettle provided with mixing means like e.g. horizontally placed Z-shaped arms. The kettle has been preheated for 15 minutes to a temperature of about 60-80°C. The mixture is mixed for 10-20 minutes until the whole mixture becomes homogeneous.

30 The mixture is then discharged into the pan and allowed to cool to room temperature from the discharged temperature of 60-80°C.

**EXAMPLE 6**

35 **Preparation of Chewing gum**

[0127] All chewing gum formulations are prepared with the following basic formulation:

Peppermint:	
Ingredients	Percent by weight
Gum base	32
Sorbitol	43.8
Lycasin	3
Peppermint oil	1.5
Menthol crystals	0.5
Aspartame	0.1
Acesulfame	0.1
Xylitol	6
Softeners	6
Emulsifiers	2
Fillers	5

55 [0128] The softeners, emulsifiers and fillers may alternatively be added to the polymers as a part of the gum base preparation.

Table 2: Peppermint chewing gum

Chewing gum	Added ingredients	Gum base Ref.
2001	2% lecithin, 2% glycerin	201
2002	2% lecithin, 2% glycerin	202
2003	-	203
2004	-	204
2005	-	205
2006	-	206
2007	2% lecithin, 2% glycerin	207
2008	-	208
2009	-	209
2010	-	210

[0129] The chewing gum products are prepared as follows:

[0130] The gum base is added to a mixing kettle provided with mixing means like e.g. horizontally placed Z-shaped arms. The kettle has been preheated for 15 minutes to a temperature of about 60-80°C or the chewing gum is made in one step, immediately after preparation of gum base in the same mixer where the gum base and kettle has a temperature of about 60-80°C.

[0131] One half portion of the sorbitol is added together with the gum base and mixed for 3 minutes. Peppermint and menthol are then added to the kettle and mixed for 1 minute. The remaining half portion of sorbitol is added and mixed for 1 minute. Softeners are slowly added and mixed for 7 minutes. Then aspartame and acesulfame are added to the kettle and mixed for 3 minutes. Xylitol is added and mixed for 3 minutes. The resulting gum mixture is then discharged and e.g. transferred to a pan at a temperature of 40-48 °C. The gum is then rolled and scored into cores, sticks, balls, cubes, and any other desired shape, optionally followed by coating and polishing processes prior to packaging.

[0132] Evidently, within the scope of the invention, other processes and ingredients may be applied in the process of manufacturing the chewing gum. Variations of different ingredients are listed and explained below.

[0133] The chewing gum according to the invention may comprise coloring agents. According to an embodiment of the invention, the chewing gum may comprise color agents and whiteners such as FD&C-type dyes and lakes, fruit and vegetable extracts, titanium dioxide and combinations thereof. Further useful chewing gum base components include antioxidants, e.g. butylated hydroxytoluene (BHT), butyl hydroxyanisol (BHA), propylgallate and tocopherols, and preservatives.

[0134] In an embodiment of the invention, the chewing gum comprises softeners in an amount of about 0 to about 18% by weight of the chewing gum, more typically about 0 to about 12% by weight of the chewing gum.

[0135] Softeners/emulsifiers may according to the invention be added both in the chewing gum and the gum base.

[0136] A gum base formulation may, in accordance with the present invention, comprise one or more softening agents e.g. sucrose polyesters including those disclosed in WO 00/25598, which is incorporated herein by reference, tallow, hydrogenated tallow, hydrogenated and partially hydrogenated vegetable oils, cocoa butter, degreased cocoa powder, glycerol monostearate, glycerol triacetate, lecithin, mono-, di- and triglycerides, acetylated monoglycerides, fatty acids (e.g. stearic, palmitic, oleic and linoleic acids), and combinations thereof. As used herein the term "softener" designates an ingredient, which softens the gum base or chewing gum formulation and encompasses waxes, fats, oils, emulsifiers, surfactants and solubilisers.

[0137] To soften the gum base further and to provide it with water-binding properties, which confer to the gum base a pleasant smooth surface and reduce its adhesive properties, one or more emulsifiers are/are usually added to the composition, typically in an amount of 0 to 18% by weight, preferably 0 to 12% by weight of the gum base. Mono- and diglycerides of edible fatty acids, lactic acid esters and acetic acid esters of mono- and diglycerides of edible fatty acids, acetylated mono and diglycerides, sugar esters of edible fatty acids, Na<sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup> and Ca<sup>2+</sup>-stearates, lecithin, hydroxylated lecithin and the like are examples of conventionally used emulsifiers which can be added to the chewing gum base. In case of the presence of a biologically or pharmaceutically active ingredient as defined below, the formulation may comprise certain specific emulsifiers and/or solubilisers in order to disperse and release the active ingredient.

[0138] Waxes are conventionally used for the adjustment of the consistency and for softening of the chewing gum base when preparing chewing gum bases. In connection with the present invention any conventionally used and suitable

type of wax may be used, such as for instance rice bran wax, polyethylene wax, petroleum wax (refined paraffin and microcrystalline wax), paraffin, bees'wax, carnauba wax or candelilla wax. In an embodiment of the invention, the gum base is wax-free.

[0139] In an embodiment of the invention, the chewing gum comprises filler.

5 [0140] A chewing gum base formulation may, if desired, include one or more fillers/texturisers including as examples, magnesium and calcium carbonate, sodium sulphate, ground limestone, silicate compounds such as magnesium and aluminum silicate, kaolin and clay, aluminum oxide, silicon oxide, talc, titanium oxide, mono-, di- and tri-calcium phosphates, cellulose polymers, such as wood, and combinations thereof.

10 [0141] In an embodiment of the invention, the chewing gum comprises filler in an amount of about 0 to about 50% by weight of the chewing gum, more typically about 10 to about 40% by weight of the chewing gum.

[0142] In the present context, chewing gum ingredients may for example comprise bulk sweeteners, high-intensity sweeteners, flavoring agents, softeners, emulsifiers, coloring agents, binding agents, acidulants, fillers, antioxidants and other components such as pharmaceutically or biologically active substances, conferring desired properties to the finished chewing gum product.

15 [0143] Suitable bulk sweeteners include both sugar and non-sugar sweetening components. Bulk sweeteners typically constitute from about 5 to about 95% by weight of the chewing gum, more typically about 20 to about 80% by weight such as 30 to 60% by weight of the gum.

[0144] Useful sugar sweeteners are saccharide-containing components commonly known in the chewing gum art including, but not limited to, sucrose, dextrose, maltose, dextrins, trehalose, D-tagatose, dried invert sugar, fructose, 20 levulose, galactose, corn syrup solids, and the like, alone or in combination.

[0145] Sorbitol can be used as a non-sugar sweetener. Other useful non-sugar sweeteners include, but are not limited to, other sugar alcohols such as mannitol, xylitol, hydrogenated starch hydrolysates, maltitol, isomaltol, erythritol, lactitol and the like, alone or in combination.

[0146] High-intensity artificial sweetening agents can also be used alone or in combination with the above sweeteners. Preferred-high intensity sweeteners include, but are not limited to sucralose, aspartame, salts of acesulfame, altame, saccharin and its salts, cyclamic acid and its salts, glycyrrhizin, dihydrochalcones, thaumatin, monellin, sterioside and the like, alone or in combination. In order to provide longer lasting sweetness and flavor perception, it may be desirable to encapsulate or otherwise control the release of at least a portion of the artificial sweetener. Techniques such as wet granulation, wax granulation, spray drying, spray chilling, fluid bed coating, coacervation, encapsulation in yeast cells and fiber extrusion may be used to achieve the desired release characteristics. Encapsulation of sweetening agents can also be provided using another chewing gum component such as a resinous compound.

[0147] Usage level of the artificial sweetener will vary considerably and will depend on factors such as potency of the sweetener, rate of release, desired sweetness of the product, level and type of flavor used and cost considerations. Thus, the active level of artificial sweetener may vary from about 0.02 to about 30% by weight, preferably 0.02 to about 35 8% by weight. When carriers used for encapsulation are included, the usage level of the encapsulated sweetener will be proportionately higher. Combinations of sugar and/or non-sugar sweeteners can be used in the chewing gum formulation processed in accordance with the invention. Additionally, the softener may also provide additional sweetness such as aqueous sugar or alcohol solutions.

[0148] If a low calorie gum is desired, a low caloric bulking agent can be used. Examples of low caloric bulking agents include polydextrose, Raftilose, Raftilin, fructooligosaccharides (NutraFlora<sup>®</sup>), palatinose oligosaccharides; guar gum hydrolysates (e.g. Sun Fiber<sup>®</sup>) or indigestible dextrins (e.g. Fibersol<sup>®</sup>). However, other low calorie-bulking agents can be used.

[0149] The chewing gum according to the present invention may contain aroma agents and flavoring agents including natural and synthetic flavorings e.g. in the form of natural vegetable components, essential oils, essences, extracts, 45 powders, including acids and other substances capable of affecting the taste profile. Examples of liquid and powdered flavorings include coconut, coffee, chocolate, vanilla, grape fruit, orange, lime, menthol, liquorice, caramel aroma, honey aroma, peanut, walnut, cashew, hazelnut, almonds, pineapple, strawberry, raspberry, tropical fruits, cherries, cinnamon, peppermint, wintergreen, spearmint, eucalyptus, and mint, fruit essence such as from apple, pear, peach, strawberry, apricot, raspberry, cherry, pineapple, and plum essence. The essential oils include peppermint, spearmint, menthol, eucalyptus, clove oil, bay oil, anise, thyme, cedar leaf oil, nutmeg, and oils of the fruits mentioned above.

[0150] The chewing gum flavor may be a natural flavoring agent, which is freeze-dried, preferably in the form of a powder, slices or pieces or combinations thereof. The particle size may be less than 3 mm, less than 2 mm or more preferred less than 1 mm, calculated as the longest dimension of the particle. The natural flavoring agent may in a form where the particle size is from about 3  $\mu$ m to 2 mm, such as from 4  $\mu$ m to 1 mm. Preferred natural flavoring agents 55 include seeds from fruit e.g. from strawberry, blackberry and raspberry.

[0151] Various synthetic flavors, such as mixed fruit flavors may also be used in the present chewing gum centers. As indicated above, the aroma agent may be used in quantities smaller than those conventionally used. The aroma agents and/or flavors may be used in the amount from 0.01 to about 30% by weight of the final product depending on

the desired intensity of the aroma and/or flavor used. Preferably, the content of aroma/flavor is in the range of 0.2 to 3% by weight of the total composition.

[0152] In an embodiment of the invention, the flavoring agents comprise natural and synthetic flavorings in the form of natural vegetable components, essential oils, essences, extracts, powders, including acids and other substances capable of affecting the taste profile

[0153] Further chewing gum ingredients, which may be included in the chewing gum according to the present invention, include surfactants and/or solubilisers, especially when pharmaceutically or biologically active ingredients are present. As examples of types of surfactants to be used as solubilisers in a chewing gum composition according to the invention, reference is made to H.P. Fiedler, Lexikon der Hilfsstoffe für Pharmacie, Kosmetik und Angrenzende Gebiete, page 63-64 (1981) and the lists of approved food emulsifiers of the individual countries. Anionic, cationic, amphoteric or non-ionic solubilisers can be used. Suitable solubilisers include lecithin, polyoxyethylene stearate, polyoxyethylene sorbitan fatty acid esters, fatty acid salts, mono and diacetyl tartaric acid esters of mono and diglycerides of edible fatty acids, citric acid esters of mono and diglycerides of edible fatty acids, saccharose esters of fatty acids, polyglycerol esters of fatty acids, polyglycerol esters of interesterified castor oil acid (E476), sodium stearoylalylate, sodium lauryl sulfate and sorbitan esters of fatty acids and polyoxyethylated hydrogenated castor oil (e.g. the product sold under the trade name CREMOPHOR), block copolymers of ethylene oxide and propylene oxide (e.g. products sold under trade names PLURONIC and POLOXAMER), polyoxyethylene fatty alcohol ethers, polyoxyethylene sorbitan fatty acid esters, sorbitan esters of fatty acids and polyoxyethylene stearic acid esters.

[0154] Particularly suitable solubilisers are polyoxyethylene stearates, such as for instance polyoxyethylene(8)stearate and polyoxyethylene(40)stearate, the polyoxyethylene sorbitan fatty acid esters sold under the trade name TWEEN, for instance TWEEN 20 (mono laurate), TWEEN 80 (monooleate), TWEEN 40 (monopalmitate), TWEEN 60 (monostearate) or TWEEN 65 (tristearate), mono and diacetyl tartaric acid esters of mono and diglycerides of edible fatty acids, citric acid esters of mono and diglycerides of edible fatty acids, sodium stearoylalylate, sodium laurylsulfate, polyoxyethylated hydrogenated castor oil, blockcopolymer of ethylene oxide and propyleneoxide and polyoxyethylene fatty alcohol ether. The solubiliser may either be a single compound or a combination of several compounds. In the presence of an active ingredient, the chewing gum may preferably also comprise a carrier known in the art.

[0155] In one embodiment the chewing gum according to the invention comprises a pharmaceutically, cosmetically or biologically active substance. Examples of such active substances, a comprehensive list of which is found e.g. in WO 00/25598, which is incorporated herein by reference, include drugs, dietary supplements, antiseptic agents, pH-adjusting agents, anti-smoking agents and substances for the care or treatment of the oral cavity and teeth such as hydrogen peroxide and compounds capable of releasing urea during chewing. Examples of useful active substances in the form of antiseptics include salts and derivatives of guanidine and biguanidine (for instance chlorhexidine diacetate) and the following types of substances with limited water-solubility: quaternary ammonium compounds (e.g. ceramine, chloroxylenol, crystal violet, chloramine), aldehydes (e.g. paraformaldehyde), derivatives of dequaline, polynoxynol, phenols (e.g. thymol, p-chlorophenol, cresol), hexachlorophene, salicylic anilide compounds, triclosan, halogenes (iodine, iodophores, chloroamidine, dichlorocyanuric acid salts), alcohols (3,4 dichlorobenzyl alcohol, benzyl alcohol, phenoxyethanol, phenoxyethanol), cf. also Martindale, The Extra Pharmacopoeia, 28th edition, page 547-578; metal salts, complexes and compounds with limited water-solubility, such as aluminum salts, (for instance aluminum potassium sulphate  $AlK(SO_4)_2 \cdot 12H_2O$ ) and salts, complexes and compounds of boron, barium, strontium, iron, calcium, zinc, (zinc acetate, zinc chloride, zinc gluconate), copper (copper chloride, copper sulphate), lead, silver, magnesium, sodium, potassium, lithium, molybdenum, vanadium should be included; other compositions for the care of mouth and teeth: for instance salts, complexes and compounds containing fluorine (such as sodium fluoride, sodium monofluorophosphate, aminofluorides, stannous fluoride), phosphates, carbonates and selenium. Further active substances can be found in J. Dent. Res. Vol. 28 No. 2, page 160-171, 1949.

[0156] Examples of active substances in the form of agents adjusting the pH in the oral cavity include: acids, such as adipic acid, succinic acid, fumaric acid, or salts thereof or salts of citric acid, tartaric acid, malic acid, acetic acid, lactic acid, phosphoric acid and glutaric acid and acceptable bases, such as carbonates, hydrogen carbonates, phosphates, sulphates or oxides of sodium, potassium, ammonium, magnesium or calcium, especially magnesium and calcium.

[0157] Active ingredients may comprise the below-mentioned compounds or derivatives thereof but are not limited thereto: Acetaminophen, Acetylsalicylysre Buprenorphine Bromhexin Celcoix Codeine, Diphenhydramin, Diclofenac, Etoricoxib, Ibuprofen, Indometacin, Ketoprofen, Lumiracoxib, Morphine, Naproxen, Oxycodon, Parecoxib, Piroxicam, Pseudoephedrin, Rofecoxib, Tenoxicam, Tramadol, Valdecoxib, Calciumcarbonat, Magaldrate, Disulfiram, Bupropion, Nicotine, Azithromycin, Clarithromycin, Clotrimazole, Erythromycin, Tetracycline, Granisetron, Ondansetron, Prometazin, Tropisetron, Brompheniramine, Ceterizin, Ico-Ceterizin, Chlorycizine, Chlorpheniramin, Chlorpheniramin, Difenhydramine, Doxylamine, Fenofenadine, Guafenesin, Loratadin, des-Loratadin, Phenyltoloxamine, Promethazin, Pyridamine, Terfenadin, Troxerutin, Methyldopa, Methylphenidate, Benzalcon. Chloride, Benzeth. Chloride, Cetypyrid. Chloride, Chlorhexidine, Ecabet-sodium, Haloperidol, Allopurinol, Colchicine, Theophylline, Propanolol, Prednisolone, Prednisone, Fluoride, Urea, Miconazole, Actot, Gilbenclamide, Glipizide, Metformin, Miglitol, Repaglinide, Rosiglitazone,

Apomorfin, Cialis, Sildenafil, Vardenafil, Diphenoxylate, Simethicone, Cimetidine, Famotidine, Ranitidine, Ratinidine, ceftriaxone, Loratadine, Aspirin, Benzocaine, Dextromethorphan, Ephedrine, Phenylpropanolamine, Pseudoephedrine, Cisapride, Domperidone, Metoclopramide, Acyclovir, Diethylsulfosucc., Phenolphthalein, Almotriptan, Eletriptan, Ergotamine, Migea, Naratriptan, Rizatriptan, Sumatriptan, Zolmitriptan, Aluminum salts, Calcium salts, Ferro salts, Silver salts, Zinc salts, Amphotericin B, Chlorhexidine, Miconazole, Triamcinolonacetonid, Melatonin, Phenobarbital, Caffeine, Benzodiazepiner, Hydroxyzine, Meprobamate, Phenothiazine, Buclizine, Brometazine, Cinnarizine, Cydizine, Difenhydramine, Dimenhydrinate, Buflomedil, Amphetamine, Caffeine, Ephedrine, Orlistat, Phenylephedrine, Phenylpropanolamin, Pseudoephedrine, Sibutramin, Ketocconazole, Nitroglycerin, Nystatin, Progesterone, Testosterone, Vitamin B12, Vitamin C, Vitamin A, Vitamin D, Vitamin E, Pilocarpin, Aluminunaminoacetat, Cimetidine, Esomeprazole, Famotidine, Lansoprazole, Magnesiumoxide, Nizatidine and/or Ratinidine.

[0158] Generally, it is preferred that the chewing gum and the gum bases prepared according to the invention is based solely on biodegradable polymers. However, within the scope of the invention further conventional chewing gum elastomers or elastomer plasticizers may be applied. Thus, in an embodiment of the invention, the at least one biodegradable polymer comprises from at least 5% to at least 90% of the chewing gum polymers and where the rest of the polymers comprise polymers generally regarded as non-biodegradable, such as natural resins, synthetic resins and/or synthetic elastomers.

[0159] The chewing gum according to the invention may be provided with an outer coating. The applicable hard coating may be selected from the group comprising of sugar coating and a sugarless coating and a combination thereof. The hard coating may e.g. comprise 50 to 100% by weight of a polyol selected from the group consisting of sorbitol, maltitol, 20 mannitol, xylitol, erythritol, lactitol and isomalt and variations thereof. In an embodiment of the invention, the outer coating is an edible film comprising at least one component selected from the group consisting of an edible film-forming agent and a wax. The film-forming agent may e.g. be selected from the group comprising cellulose derivative, a modified starch, a dextrin, gelatine, shellac, gum arabic, zein, a vegetable gum, a synthetic polymer and any combination thereof. In an embodiment of the invention, the outer coating comprises at least one additive component selected from the group comprising of a binding agent, a moisture-absorbing component, a film-forming agent, a dispersing agent, an anti-sticking component, a bulking agent, a flavoring agent, a coloring agent, a pharmaceutically or cosmetically active component, a lipid component, a wax component, a sugar, an acid and an agent capable of accelerating the after-chewing degradation of the degradable polymer.

[0160] In a further embodiment of the invention, the outer coating is a soft coating. The soft coating may comprise sugar free coating agent.

## EXAMPLE 7

[0161] An experiment was set up in order to test chewing gum 2001 containing the blend of pure polyester type 2 polymer based gum base compared with chewing gum 2007 containing the gum base based on a mixture of polyester type 1 and polyester type 2 polymers 2007, prepared and described in EXAMPLE 6.

The gum centers were chewed in a chewing machine (CF Jansson). The chewing frequency was set to 1 Hz, a pH buffer was used as saliva and the temperature was set at 37°C. The chewing time was set to 60 seconds. After chewing, the chewed cud was measured using a rheometer, type AR1000 from TA Instruments. The oscillation measurement is performed at a stress within the linear viscoelastic region at a temperature of 37°C with a parallel plate system (d=2.0 cm, hatched). G' vs. shear rate, and G', G'' vs. frequency.

[0162] The results from these measurements can be seen in fig. 1 (stress sweep) and fig. 2 (frequency sweep).

[0163] From fig. 1 it can be seen that the chewing gum formulation containing polymer blends has a higher elastic modulus, meaning the chewing gum 2007 has improved texture property compared to the chewing gum formulation 2001 which contains only polyester type 2 based polymers.

[0164] Fig. 2 shows both the storage modulus G' and the elastic modulus G', a crossover between G' and G'' is a sign of high elasticity, a crossover found at low frequency means higher elasticity compared with a crossover found at higher frequency. Again it is found that 2007 has higher elasticity compared to 2001 resulting in a crossover found at lower frequency.

[0165] The above rheological results confirm the fact that chewing gum containing gum bases made with the right combination of different polymers (polyester type 1 elastomer and polyester type 2 resin) has a texture closer to conventional gum bases and chewing gum, as compared to chewing gum containing gum bases only consisting of polyester type 2 based polymers.

[0166] The two chewing gum samples 2001 and 2007 were tested by serving them to the sensory panellists in tasting booths made in accordance with ISO 8598 standards at room temperature in 40 ml tasteless plastic cups with randomised 3-figure codes. Test samples were evaluated after chewing for 0-0.30 minutes (initial phase 1), 0.30-1 minutes (initial phase 2), 1-1.30 minutes (initial phase 3), 1-1.30 minutes (intermediate phase 1), 4-4.30 minutes (intermediate 2), 4.30-5 minutes (intermediate phase 3), 9-9.30 minutes (end phase 1), 9.30-10 minutes (end phase 2) respectively. Between

each sample tested, the panelists were allowed a break of 3 minutes. Every test is repeated.

[0167] The following texture parameters were assessed: softness, juicy, mint, cooling, slippery, sweetness, bitter note, elasticity and volume. For each of these parameters, the panelists were required to provide their assessments according to an arbitrary scale of 0-15. The data obtained were processed using a FIZZ computer program (French Bio System) and the results were transformed to sensory profile diagrams as shown in fig. 3, fig. 4 and fig. 5. The major differences between test chewing gums in all phases were the following:

[0168] Chewing gums prepared with a gum base comprising of a mixture of polyester type 1 and polyester type 2 polymers showed a significantly higher elasticity, bigger volume and softer texture than corresponding chewing gums prepared with a gum base based only on polyester type 2 polymers. All three parameters are different in a positive direction compared with polyester type 2 based chewing gums, which lacks elasticity, volume and softness.

[0169] Major differences were also found on taste parameters in the intermediate and end testing phase, were the chewing gum based on a mixture of polyester type 1 and polyester type 2 showed significant higher mint, cooling and sweetness sensations. This is an important improvement compared to polyester type 2 biodegradable formulations where the period of flavor sensation is somewhat short compared to conventional chewing gum.

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#### EXAMPLE 8

[0170] An experiment was set up in order to measure the influence of different blends of polyester type 1 and polyester type 2 (203-210).

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[0171] Accordingly, the following rheological parameters were measured using a rheometer, as described in Example 7. All gum base formulations were evaluated measuring stress sweep and frequency sweep at 100°C.

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[0172] The results are summarized in fig. 6 and 7, as it appears that the higher amount of elastomer polymer as described in Example 4, the higher elastic property of the respective gum bases. From fig. 7 it appears that none of the gum bases shows crossovers between G' and G'', but there is a clear tendency showing G' and G'' get closer with a higher content of elastomer.

[0173] The rheology of gum bases containing low amounts of elastomer (203 and 204) shows similar curves, due to the minor difference in elastomer content.

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#### EXAMPLE 9

[0174] In table 3 a number of formulations are evaluated by a panel according to sweetness, mint, cooling, juicy, elasticity, softness 1, softness 2, volume and creakiness. The scale used for the evaluation was as follows: 1 being the lowest rating and 5 being the highest rating.

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Chewing gum	Gum base	Ratio elastomer /resin	Sensory evaluation								
			Sweetness	Mint	Cooling	Juicy	Elasticity	Softness 1	Softness 2	Volume	Creaky
2003	203	5/95	3	3	2	3	1	1	1	1	0
2004	204	10/90	3	3	2	3	2	1	2	2	0
2005	205	25/75	3	3	2	4	2	2	3	2	0
2006	206	40/60	2	2	2	3	3	3	3	3	0
2008	208	60/40	4	2	3	3	4	2	4	4	0
2009	209	80/20	3	3	3	3	4	2	2	4	0
2010	210	95/5	2	2	3	3	5	2	3	4	0

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Table 3: Sensory evaluation of peppermint chewing gum prepared with different ratios of polyester type 1 elastomer and polyester type 2 resin.

[0175] As it can be seen from table 3, using different combinations of different polymers offers the possibility of adjusting the texture and flavor into the desired properties. Different combinations of polyester type 1 elastomer and polyester type 2 resin give different texture and flavor profiles.

[0176] The profile shows higher elasticity with increasing amount of polyester type 1 elastomer. Moreover, based on the overall sensory texture evaluations on elasticity, softness, volume and creakiness, it is observed that there is an optimum texture profile found when using the combination 60% polyester type 1 elastomer and 40% polyester type 2 resin.

## Claims

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1. Chewing gum comprising at least two different biodegradable polymers wherein at least two of said biodegradable polymers comprise a polyester polymer, wherein at least one of said at least two different biodegradable polymers comprises at least one biodegradable elastomer and at least one of said at least two different biodegradable polymers comprises at least one biodegradable elastomer plasticizer, said biodegradable plasticizer comprising at least one biodegradable polymer.
2. Chewing gum comprising at least two different biodegradable polymers according to claim 1, wherein at least one of said at least two different biodegradable polymers comprises a polyester produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof.
3. Chewing gum comprising at least two different biodegradable polymers according to claim 1 or 2, wherein said alcohol derivative comprises an ester of an alcohol.
4. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-3, wherein said acid derivative comprises esters, anhydrides or halides of carboxylic acids.
5. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-4, wherein said acid derivative comprises methyl esters of acids.
6. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-5, wherein said alcohols or derivatives thereof comprises polyols.
7. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-6, wherein said acids or derivatives thereof comprise polyfunctional carboxylic acids.
8. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-7, wherein said at least one biodegradable polymer produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof has a PD of 1.1 to 20, preferably 1.3 to 12.
9. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-8, wherein at least one of said at least two different biodegradable polymers comprises a polyester obtained by polymerization of at least one cyclic ester.
10. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-9, wherein said polyester obtained by polymerization of at least one cyclic ester is at least partly derived from  $\alpha$ -hydroxy acids such as lactic and glycolic acids.
11. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-10, wherein said polyester obtained by polymerization of at least one cyclic ester is at least partly derived from  $\alpha$ -hydroxy acids and where the obtained polyester comprises at least 20 mole%  $\alpha$ -hydroxy acids units, preferably at least 50 mole%  $\alpha$ -hydroxy acids units and most preferably at least 80 mole%  $\alpha$ -hydroxy acids units.
12. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-11, wherein the at least two or more cyclic esters are selected from the groups of glycolides, lactides, lactones, cyclic carbonates or mixtures thereof.
13. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-12, wherein lactone monomers are chosen from the group of  $\epsilon$ -caprolactone,  $\delta$ -valerolactone,  $\gamma$ -butyrolactone, and  $\beta$ -propiolac-

tone. It also includes  $\epsilon$ -caprolactones,  $\delta$ -valerolactones,  $\gamma$ -butyrolactones, or  $\beta$ -propiolactones that have been substituted with one or more alkyl or aryl substituents at any non-carbonyl carbon atoms along the ring, including compounds in which two substituents are contained on the same carbon atom.

5. 14. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-13, wherein the carbonate monomer is selected from the group of trimethylene carbonate, 5-alkyl-1,3-dioxan-2-one, 5,5-dialkyl-1,3-dioxan-2-one, or 5-alkyl-5-alkyloxycarbonyl-1,3-dioxan-2-one, ethylene carbonate, 3-ethyl-3-hydroxymethyl, propylene carbonate, trimethylolpropane monocarbonate, 4, 6dimethyl-1, 3-propylene carbonate, 2, 2-dimethyl trimethylene carbonate, and 1, 3-dioxepan-2-one and mixtures thereof.

10. 15. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-14, wherein cyclic ester polymers and their copolymers resulting from the polymerization of cyclic ester monomers comprising poly (L-lactide); poly (D-lactide); poly (D, L-lactide); poly (mesolactide); poly (glycolide); poly (trimethylene carbonate); poly (epsilon-caprolactone); poly (L-lactide-co-D, L-lactide); poly (L-lactide-co-mesolactide); poly (L-lactide-co-glycolide); poly (L-lactide-co-trimethylene carbonate); poly (L-lactide-co-epsilon-caprolactone); poly (D, L-lactide-co-meso-lactide); poly (D, L-lactide-co-epsilon-caprolactone); poly (D, L-lactide-co-glycolide); poly (meso-lactide-co-trimethylene carbonate); poly (meso-lactide-co-epsilon-caprolactone); poly (meso-lactide-co-epsilon-caprolactone); poly (glycolide-co-epsilon-caprolactone); poly (glycolide-co-epsilon-caprolactone).

15. 16. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-15, wherein said polyester obtained by polymerization of at least one cyclic ester has a PD of 1.1 to 15, preferably 1.3 to 9.

20. 17. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-16, wherein at least one of said at least one biodegradable elastomers comprises said polyester produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof.

25. 18. Chewing gum comprising at least two different biodegradable polymers according to claim 17, wherein said elastomer is produced through reaction of at least one acid chosen from terephthalic, phthalic, adipic, pimelic acids or combinations thereof with at least one alcohol chosen from the groups of diethylene and 1,4-butylene diols or combinations thereof.

30. 19. Chewing gum comprising at least two different biodegradable polymers according to claim 17 or 18, wherein said at least one biodegradable elastomer produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof has a molecular weight of 10000-250000 g/mol (Mn), preferably 20000-150000 g/mol (Mn).

35. 20. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-19, wherein at least one of said biodegradable elastomer plasticizers comprises said polyester produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof.

40. 21. Chewing gum comprising at least two different biodegradable polymers according to claim 20, wherein said elastomer plasticizer is produced through reaction of at least one acid chosen from terephthalic, succinic, malonic, and adipic acids or combinations thereof with at least one alcohol chosen from ethylene, diethylene or 1,4-butylene diols and combinations thereof.

45. 22. Chewing gum comprising at least two different biodegradable polymers according to claim 20 or 21, wherein said at least one biodegradable elastomer plasticizer produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof has a molecular weight of 500-19000 g/mol (Mn), preferably 1500-9000 g/mol (Mn).

50. 23. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-22, wherein at least one of said biodegradable elastomers comprises said polyester obtained by polymerization of at least one cyclic ester.

55. 24. Chewing gum comprising at least two different biodegradable polymers according to claim 23, wherein the molecular weight of said biodegradable elastomer comprising at least one of said polyesters obtained by polymerization of at least one cyclic ester is within the range of 10000 - 1000000 g/mol (Mn), preferably within the range of 30000 -

250000 g/mol (Mn).

5 25. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-24, wherein at least one of said biodegradable elastomer plasticizers comprises said polyester obtained by polymerization of at least one cyclic ester.

10 26. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-25, wherein said chewing gum comprises at least one elastomer plasticizer comprising at least one of said polyesters obtained by polymerization of at least one cyclic ester and at least one elastomer comprising at least one of said polyesters produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof.

15 27. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-26, wherein the at least two different polymers are hydrophilic.

20 28. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-27, wherein the difference in molecular weight between the at least two different polymers is at least 1000 g/mol Mn.

25 29. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-28, wherein the difference in molecular weight between the at least two different polymers is at least 20000 g/mol, preferably at least 50000 g/mol Mn.

30 30. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-29, wherein the molecular weight of said biodegradable plasticizer comprising at least one of said polyesters obtained by polymerization of at least one cyclic ester is in the range of 500 - 19000 g/mol, preferably within the range of 1500 - 9000 g/mol Mn.

35 31. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-30, wherein said at least two different biodegradable polymers have a different glass transition temperature Tg.

40 32. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-31, wherein at least one of the applied biodegradable polymers, preferably a plasticizer, has a glass transition temperature of at least +1°C, preferably at least +10°C and more preferably at least +20°C.

45 33. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-32, wherein at least one of the at least two different biodegradable polymers has a glass transition temperature of less than 0°C, preferably less than -30°C and more preferably less than -50°C.

50 34. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-33, wherein the resulting chewing gum has at least two different glass transition temperatures Tg.

55 35. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-34, wherein the chewing gum comprises at least one biodegradable elastomer having a glass transition temperature Tg below 0°C and at least one biodegradable plasticizer having a glass transition temperature Tg exceeding 0°C.

60 36. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-35, wherein said chewing gum comprises at least one biodegradable elastomer in the amount of 0.5 to 70% by weight of the chewing gum, at least one biodegradable plasticizer in the amount of 0.5 to 70% by weight of the chewing gum and at least one chewing gum ingredient chosen from the groups of softeners, sweeteners, flavoring agents, active ingredients and fillers in the amount of 2 to 80% by weight of the chewing gum.

65 37. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-36, wherein all the biodegradable polymers comprised in the chewing gum comprise at least 25%, preferably at least 50% of the chewing gum polymers.

70 38. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-37, wherein all the biodegradable polymers comprised in the chewing gum comprise at least 80%, preferably at least 90% of the chewing gum polymers.

39. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-38, wherein the chewing gum is substantially free of non-biodegradable polymers.

5 40. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-39, wherein said chewing gum ingredients comprise flavoring agents.

10 41. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-40, wherein said chewing gum comprises flavor in the amount of 0.01 to 30 % by weight, said percentage being based on the total weight of the chewing gum, preferably 0.2 to 4 % by weight, said percentage being based on the total weight of the chewing gum.

15 42. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-41, wherein said chewing gum ingredients comprise sweeteners.

20 43. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-42, wherein the chewing gum comprises bulk sweeteners in the amount of 5 to 95 % by weight of the chewing gum, more typically 20 to 80 % by weight of the chewing gum.

25 44. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-43, wherein the chewing gum comprises high-intensity sweeteners in the amount of 0 to 3 % by weight of the chewing gum, more typically 0.05 to 0.5 % by weight of the chewing gum.

30 45. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-44, wherein the chewing gum comprises at least one softener in the amount of 0 to 18 % by weight of the chewing gum, more typically 0 to 12 % by weight of the chewing gum.

35 46. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-45, wherein said chewing gum ingredients comprise active ingredients.

40 47. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-46, wherein the chewing gum comprises filler in an amount of 0 to 50 % by weight of the chewing gum, preferably 10 to 40 % by weight of the chewing gum.

45 48. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-47, wherein the chewing gum comprises at least one coloring agent.

50 49. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-48, wherein the chewing gum is coated with an outer coating.

55 50. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-49, wherein said chewing gum comprises at least one elastomer comprising at least one of said polyesters obtained by polymerization of at least one cyclic ester and at least one elastomer plasticizer comprising at least one of said polyesters produced through reaction of at least one alcohol or derivative thereof and at least one acid or derivative thereof.

51. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-50 wherein said chewing gum is wax-free.

52. Chewing gum comprising at least two different biodegradable polymers according to any of the claims 1-50, wherein said chewing gum comprises wax.

53. Chewing gum according to any of the claims 1-39, wherein the chewing gum is a gum base.

55 **Patentansprüche**

1. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, wobei mindestens zwei der bioabbaubaren Polymere ein Polyester-Polymer umfassen, wobei mindestens eines der mindestens zwei verschiedenen bioabbaubaren Polymere mindestens ein bioabbaubares Elastomer umfasst und mindestens eines der mindestens

zwei verschiedenen bioabbaubaren Polymere mindestens einen bioabbaubaren Elastomer-Weichmacher umfasst, wobei der bioabbaubare Weichmacher mindestens ein bioabbaubares Polymer umfasst.

- 5 2. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach Anspruch 1, wobei mindestens eines der mindestens zwei verschiedene bioabbaubaren Polymere einen Polyester umfasst, der durch die Umsetzung mindestens eines Alkohols oder eines Derivats desselben und mindestens einer Säure oder eines Derivats derselben erzeugt wird.
- 10 3. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach Anspruch 1 oder 2, wobei das Alkohol-Derivat einen Ester eines Alkohols umfasst.
- 15 4. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-3, wobei das Säure-Derivat Ester, Anhydride oder Halogenide von Carbonsäuren umfasst.
- 20 5. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-4, wobei das Säure-Derivat Methylester von Säuren umfasst.
- 25 6. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-5, wobei die Alkohole oder Derivate derselben Polycole umfassen.
- 30 7. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-6, wobei die Säuren oder Derivate derselben polyfunktionelle Carbonsäuren umfassen.
- 35 8. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-7, wobei das mindestens eine bioabbaubare Polymer, das durch eine Umsetzung mindestens eines Alkohols oder eines Derivats desselben und mindestens einer Säure oder eines Derivats derselben erzeugt wird, eine PD von 1,1 bis 20, bevorzugt 1,3 bis 12 aufweist.
- 40 9. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-8, wobei mindestens eines der mindestens zwei verschiedenen bioabbaubaren Polymeren einen Polyester umfasst, der durch Polymerisation mindestens eines cyclischen Esters erhalten wird.
- 45 10. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-9, wobei der Polyester, der durch Polymerisation mindestens eines cyclischen Esters erhalten wird, zumindest teilweise von  $\alpha$ -Hydroxsäuren, wie Milch- und Glycolsäure, abgeleitet ist.
- 50 11. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-10, wobei der Polyester, der durch Polymerisation mindestens eines cyclischen Esters erhalten wird, mindestens teilweise von  $\alpha$ -Hydroxsäuren abgeleitet ist und wobei der erhaltene Polyester mindestens 20 Mol-%  $\alpha$ -Hydroxsäure-Einheiten, bevorzugt mindestens 50 Mol-%  $\alpha$ -Hydroxsäure-Einheiten und am bevorzugtesten mindestens 80 Mol-%  $\alpha$ -Hydroxsäure-Einheiten umfasst.
- 55 12. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-11, wobei die mindestens zwei oder mehr cyclischen Ester ausgewählt sind aus der Gruppe von Glycoldien, Lactiden, Lactonen, cyclischen Carbonaten oder deren Mischungen.
- 60 13. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-12, wobei Lacton-Monomere ausgewählt sind aus der Gruppe von  $\epsilon$ -Caprolacton,  $\delta$ -Valerolacton,  $\gamma$ -Butyrolacton und  $\beta$ -Propiolacton. Sie schließen auch  $\epsilon$ -Caprolactone,  $\delta$ -Valerolactone,  $\gamma$ -Butyrolactone oder  $\beta$ -Propiolactone ein, die mit einem oder mehreren Alkyl- oder Aryl-Substituenten an irgendeinem Nicht-Carbonylkohlenstoffatom entlang des Rings substituiert worden sind, einschließlich Verbindungen, in denen zwei Substituenten an demselben Kohlenstoffatom enthalten sind.
- 65 14. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-13, wobei das Carbonat-Monomer ausgewählt ist aus der Gruppe von Trimethylencarbonat, 5-Alkyl-1,3-dioxan-2-on, 5,5-Dialkyl-1,3-dioxan-2-on oder 5-Alkyl-5-alkyloxycarbonyl-1,3-dioxan-2-on, Ethylenkarbonat, 3-Ethyl-3-hydroxymethylpropylenkarbonat, Trimethylolpropanmonocarbonat, 4,6-Dimethyl-1,3-propylenkarbonat, 2,2-Dimethyltrimylenkarbonat und 1,3-Dioxepan-2-on und deren Mischungen.

15. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-14, wobei cyclische Ester-Polymeren und deren Copolymeren, die das Ergebnis der Polymerisation von cyclischen Ester-Monomeren sind, umfassen: Poly(L-lactid); Poly(D-lactid); Poly(D,L-lactid); Poly(mesolactid); Poly(glycolid); Poly(trimethylencarbonat); Poly(episilon-caprolacton); Poly(L-lactid-co-D,L-lactid); Poly(L-lactid-co-mesolactid); Poly(L-lactid-co-glycolid); Poly(L-lactid-co-trimethylencarbonat); Poly(L-lactid-co-epsilon-caprolacton); Poly(D,L-lactid-co-mesolactid); Poly(D,L-lactid-co-glycolid); Poly(D,L-lactid-co-trimethylencarbonat); Poly(D,L-lactid-co-epsilon-caprolacton); Poly(mesolactid-co-glycolid); Poly-(mesolactid-co-trimethylencarbonat); Poly(mesolactid-co-epsilon-caprolacton); Poly(glycolid-co-trimethylencarbonat); Poly(glycolid-co-epsilon-caprolacton).

16. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-15, wobei der Polyester, der durch die Polymerisation mindestens eines cyclischen Esters erhalten wird, eine PD von 1,1 bis 15, bevorzugt 1,3 bis 9 aufweist.

17. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-16, wobei mindestens eines des mindestens einen bioabbaubaren Elastomers den Polyester umfasst, der durch die Umsetzung mindestens eines Alkohols oder Derivats desselben und mindestens einer Säure oder eines Derivats derselben erzeugt wird.

18. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach Anspruch 17, wobei das Elastomer durch die Umsetzung mindestens einer Säure, die aus Terephthal-, Phthal-, Adipin-, Pimelinsäure oder deren Kombinationen ausgewählt ist, mit mindestens einem Alkohol erzeugt wird, der aus den Gruppen von Diethylen- und 1,4-Butylenol oder deren Kombinationen ausgewählt ist.

19. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach Anspruch 17 oder 18, wobei das mindestens eine bioabbaubare Elastomer, das durch die Umsetzung mindestens eines Alkohols oder eines Derivats desselben und mindestens einer Säure oder eines Derivats desselben erzeugt wird, ein Molekulargewicht von 10000-250000 g/Mol (Mn), vorzugsweise 20000-150000 g/Mol (Mn) aufweist.

20. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-19, wobei mindestens einer der bioabbaubaren Elastomer-Weichmacher den Polyester umfasst, der durch die Umsetzung mindestens eines Alkohols oder eines Derivats desselben und mindestens einer Säure oder eines Derivats derselben erzeugt wird.

21. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach Anspruch 20, wobei der Elastomer-Weichmacher durch die Umsetzung mindestens einer Säure, die aus Terephthal-, Bernstein-, Malon- und Adipinsäure oder deren Kombinationen ausgewählt ist, mit mindestens einem Alkohol erzeugt wird, der aus Ethylen-, Diethylen- oder 1,4-Butylenol und deren Kombinationen ausgewählt ist.

22. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach Anspruch 20 oder 21, wobei der mindestens eine bioabbaubare Elastomer-Weichmacher, der durch die Umsetzung mindestens eines Alkohols oder eines Derivats desselben und mindestens einer Säure oder eines Derivats desselben hergestellt wird, ein Molekulargewicht von 500-19000 g/Mol (Mn), vorzugsweise 1500-9000 g/Mol (Mn) aufweist.

23. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-22, wobei mindestens einer der bioabbaubaren Elastomere den Polyester umfasst, der durch die Polymerisation mindestens eines cyclischen Esters erhalten wird.

24. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach Anspruch 23, wobei das Molekulargewicht des bioabbaubaren Elastomers, das mindestens einen der Polyester umfasst, die durch Polymerisation mindestens eines cyclischen Esters erhalten werden, im Bereich von 10000-1000000 g/Mol (Mn), vorzugsweise im Bereich von 30000-250000 g/Mol (Mn) liegt.

25. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-24, wobei mindestens einer der bioabbaubaren Elastomer-Weichmacher den Polyester umfasst, der durch Polymerisation mindestens eines cyclischen Esters erhalten wird.

26. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-25, wobei der Kaugummi mindestens einen Elastomer-Weichmacher, der mindestens einen der Polyester umfasst,

die durch die Polymerisation von mindestens einem cyclischen Ester erhalten werden, und mindestens ein Elastomer umfasst, das mindestens einen der Polyester umfasst, die durch die Umsetzung mindestens eines Alkohols oder eines Derivats desselben und mindestens einer Säure oder eines Derivats desselben erzeugt werden.

5 27. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-26, wobei die mindestens zwei verschiedenen Polymere hydrophil sind.

10 28. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-27, wobei der Unterschied im Molekulargewicht zwischen den mindestens zwei verschiedenen Polymeren mindestens 1000 g/Mol Mn beträgt.

15 29. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-28, wobei der Unterschied im Molekulargewicht zwischen den mindestens zwei verschiedenen Polymeren mindestens 20000 g/Mol, vorzugsweise mindestens 50000 g/Mol Mn beträgt.

20 30. Kaugummi, umfassend zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-29, wobei das Molekulargewicht des bioabbaubaren Weichmachers, der mindestens einen der Polyester umfasst, die durch die Polymerisation mindestens eines cyclischen Esters erhalten werden, im Bereich von 500-19000 g/Mol, bevorzugt im Bereich von 1500-8000 g/Mol Mn liegt.

25 31. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-30, wobei die mindestens zwei verschiedenen bioabbaubaren Polymere eine unterschiedliche Glasübergangstemperatur Tg aufweisen.

30 32. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-31, wobei mindestens eines der verwendeten bioabbaubaren Polymere, bevorzugt ein Weichmacher, eine Glasübergangstemperatur von mindestens +1°C, bevorzugt mindestens +10°C und bevorzugter mindestens +20°C aufweist.

35 33. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-32, wobei mindestens eines der mindestens zwei verschiedenen bioabbaubaren Polymere eine Glasübergangstemperatur von weniger als 0°C, bevorzugt weniger als -30°C und bevorzugter weniger als -50°C aufweist.

40 34. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-33, wobei der resultierende Kaugummi mindestens zwei verschiedene Glasübergangstemperaturen Tg aufweist.

45 35. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-34, wobei der Kaugummi mindestens ein bioabbaubares Elastomer mit einer Glasübergangstemperatur Tg unter 0°C und mindestens einen bioabbaubaren Weichmacher mit einer Glasübergangstemperatur Tg umfasst, die 0°C überschreitet.

50 36. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-35, wobei der Kaugummi mindestens ein bioabbaubares Elastomer in einer Menge von 0,5 bis 70 Gew.-% des Kaugummis, mindestens ein bioabbaubaren Weichmacher in einer Menge von 0,5 bis 70 Gew.-% des Kaugummis und mindestens einen Kaugummi-Bestandteil, welcher aus den Gruppen von weichmachenden Mitteln, Süßungsmitteln, Geschmacksmitteln, aktiven Bestandteilen und Füllstoffen ausgewählt ist, in einer Menge von 2 bis 80 Gew.-% des Kaugummis umfasst.

55 37. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-36, wobei alle bioabbaubaren Polymere, die in dem Kaugummi enthalten sind, mindestens 25 %, bevorzugt mindestens 50 % der Kaugummi-Polymeren umfassen.

38. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-37, wobei alle bioabbaubaren Polymere, die in dem Kaugummi enthalten sind, mindestens 80 %, bevorzugt mindestens 90 % der Kaugummi-Polymeren umfassen.

39. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-38, wobei der Kaugummi im Wesentlichen frei von nicht-bioabbaubaren Polymeren ist.

40. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-39, wobei die Kaugummi-Bestandteile Geschmacksmittel umfassen.

5 41. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-40, wobei der Kaugummi Geschmackstoff in einer Menge von 0,01 bis 30 Gew.-% umfasst, wobei der Prozentsatz auf das Gesamtgewicht des Kaugummis bezogen ist, vorzugsweise 0,2 bis 4 Gew.-%, wobei der Prozentsatz auf das Gesamtgewicht des Kaugummis bezogen ist.

10 42. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-41, wobei die Kaugummi-Bestandteile Süßungsmittel umfassen.

15 43. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-42, wobei der Kaugummi Füllstoffe in einer Menge von 5 bis 95 Gew.-% des Kaugummis, typischer 20 bis 80 Gew.-% des Kaugummis, umfasst.

20 44. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-43, wobei der Kaugummi Hochintensitäts-Süßungsmittel in einer Menge von 0 bis 3 Gew.-% des Kaugummis, typischer 0,05 bis 0,5 Gew.-% des Kaugummis umfasst.

25 45. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-44, wobei der Kaugummi mindestens ein weichmachendes Mittel in einer Menge von 0 bis 18 Gew.-% des Kaugummis, typischer 0 bis 12 Gew.-% des Kaugummis umfasst.

30 46. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-45, wobei die Kaugummi-Bestandteile aktive Bestandteile umfassen.

35 47. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-46, wobei der Kaugummi Füllstoffe in einer Menge von 0 bis 50 Gew.-% des Kaugummis, bevorzugt 10 bis 40 Gew.% des Kaugummis umfasst.

40 48. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-47, wobei der Kaugummi mindestens ein Färbemittel umfasst.

45 49. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-48, wobei der Kaugummi mit einem äußeren Überzug beschichtet ist.

50 50. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-49, wobei der Kaugummi mindestens ein Elastomer, das mindestens einen der Polyester umfasst, die durch die Polymerisation von mindestens einem cyclischen Ester erhalten werden, und mindestens einen Elastomer-Weichmacher umfasst, der mindestens einen der Polyester umfasst, die durch die Umsetzung mindestens eines Alkohols oder eines Derivats desselben und mindestens einer Säure oder eines Derivats derselben erzeugt werden.

55 51. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-50, wobei der Kaugummi wachsfrei ist.

52. Kaugummi, umfassend mindestens zwei verschiedene bioabbaubare Polymere, nach irgendeinem der Ansprüche 1-50, wobei der Kaugummi Wachs umfasst.

53. Kaugummi nach irgendeinem der Ansprüche 1-39, wobei der Kaugummi eine Gummibasis ist.

## Revendications

55 1. Chewing-gum comprenant au moins deux polymères biodégradables différents, dans lequel au moins deux desdits polymères biodégradables comprennent un polymère de polyester, dans lequel au moins l'un desdits au moins deux polymères biodégradables différents comprend au moins un élastomère biodégradable et au moins l'un desdits au moins deux polymères biodégradables différents comprend au moins un plastifiant élastomère biodégradable, ledit plastifiant biodégradable comprenant au moins un polymère biodégradable.

2. Chewing-gum comprenant au moins deux polymères biodégradables différents selon la revendication 1, dans lequel au moins l'un desdits au moins deux polymères biodégradables différents comprend un polyester produit par la réaction d'au moins un alcool ou un dérivé de celui-ci et au moins un acide ou dérivé de celui-ci.

5. Chewing-gum comprenant au moins deux polymères biodégradables différents selon la revendication 1 ou 2, dans lequel ledit dérivé d'alcool comprend un ester d'un alcool.

10. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 3, dans lequel ledit dérivé d'acide comprend des esters, des anhydrides ou des halogénures d'acides carboxyliques.

15. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 4, dans lequel ledit dérivé d'acide comprend des méthyl-esters d'acides.

20. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 5, dans lequel ledits alcools ou dérivés de ceux-ci comprennent des polyols.

25. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 6, dans lequel ledits acides ou dérivés de ceux-ci comprennent des acides carboxyliques polyfonctionnels.

30. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 7, dans lequel au moins un polymère biodégradable produit par la réaction d'au moins un alcool ou dérivé de celui-ci et au moins un acide ou dérivé de celui-ci ont une valeur PD de 1,1 à 20, de préférence de 1,3 à 12.

35. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 8, dans lequel au moins l'un desdits au moins deux polymères biodégradables différents comprend un polyester obtenu par polymérisation d'au moins un ester cyclique.

40. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 9, dans lequel ledit polyester obtenu par polymérisation d'au moins un ester cyclique est au moins partiellement dérivé d' $\alpha$ -hydroxy-acides tels que les acides lactiques et glycoliques.

45. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 10, dans lequel ledit polyester obtenu par polymérisation d'au moins un ester cyclique est partiellement dérivé d' $\alpha$ -hydroxy-acides et le polyester obtenu comprenant au moins 20 % en mole d'unités d' $\alpha$ -hydroxy-acides, de préférence au moins 50 % en mole d'unités d' $\alpha$ -hydroxy-acides et de manière préférée entre toute, de préférence au moins 80 % en mole d'unités d' $\alpha$ -hydroxy-acides.

50. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 11, dans lequel au moins deux esters cycliques ou plus sont choisis dans les groupes des glycolides, lactides, lactones, carbonates cycliques ou des mélanges de ceux-ci.

55. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 12, dans lequel les monomères lactone sont choisis dans le groupe comprenant l' $\epsilon$ -caprolactone, le  $\delta$ -valérolactone, et le  $\beta$ -propiolactone. Il comprend également les  $\epsilon$ -caprolactone,  $\delta$ -valérolactone,  $\gamma$ -butyrolactones ou  $\beta$ -propiolactones qui ont été substitués par un ou plusieurs substituants alkyle ou aryle au niveau de tout atome de carbone non carbonyle le long du cycle, comprenant les composés dans lesquels deux substituants sont contenus sur le même atome de carbone.

60. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 13, dans lequel le monomère carbonate est choisi dans le groupe comprenant le triméthylène carbonate, le 5-alkyl-1,3-dioxan-2-one, le 5,5-dialkyl-1,3-dioxan-2-one ou le 5-alkyl-5-alkyloxycarbonyl-1,3-dioxan-2-one, les éthylène-carbonates, le 3-éthyl-3-hydroxyméthyle, le propylène carbonate, le triméthylolpropane monocarbonate, le 4,6-diméthyl-1,3-propylène carbonate, le 2,2-diméthyl-triméthylène carbonate et le 1,3-dioxépan-2-one et leurs mélanges.

65. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 14, dans lequel ledit carbonate est choisi dans le groupe comprenant le triméthylène carbonate, le 5-alkyl-1,3-dioxan-2-one, le 5,5-dialkyl-1,3-dioxan-2-one ou le 5-alkyl-5-alkyloxycarbonyl-1,3-dioxan-2-one, les éthylène-carbonates, le 3-éthyl-3-hydroxyméthyle, le propylène carbonate, le triméthylolpropane monocarbonate, le 4,6-diméthyl-1,3-propylène carbonate, le 2,2-diméthyl-triméthylène carbonate et le 1,3-dioxépan-2-one et leurs mélanges.

70. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 15, dans lequel ledit carbonate est choisi dans le groupe comprenant le triméthylène carbonate, le 5-alkyl-1,3-dioxan-2-one, le 5,5-dialkyl-1,3-dioxan-2-one ou le 5-alkyl-5-alkyloxycarbonyl-1,3-dioxan-2-one, les éthylène-carbonates, le 3-éthyl-3-hydroxyméthyle, le propylène carbonate, le triméthylolpropane monocarbonate, le 4,6-diméthyl-1,3-propylène carbonate, le 2,2-diméthyl-triméthylène carbonate et le 1,3-dioxépan-2-one et leurs mélanges.

75. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 16, dans lequel ledit carbonate est choisi dans le groupe comprenant le triméthylène carbonate, le 5-alkyl-1,3-dioxan-2-one, le 5,5-dialkyl-1,3-dioxan-2-one ou le 5-alkyl-5-alkyloxycarbonyl-1,3-dioxan-2-one, les éthylène-carbonates, le 3-éthyl-3-hydroxyméthyle, le propylène carbonate, le triméthylolpropane monocarbonate, le 4,6-diméthyl-1,3-propylène carbonate, le 2,2-diméthyl-triméthylène carbonate et le 1,3-dioxépan-2-one et leurs mélanges.

80. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 17, dans lequel ledit carbonate est choisi dans le groupe comprenant le triméthylène carbonate, le 5-alkyl-1,3-dioxan-2-one, le 5,5-dialkyl-1,3-dioxan-2-one ou le 5-alkyl-5-alkyloxycarbonyl-1,3-dioxan-2-one, les éthylène-carbonates, le 3-éthyl-3-hydroxyméthyle, le propylène carbonate, le triméthylolpropane monocarbonate, le 4,6-diméthyl-1,3-propylène carbonate, le 2,2-diméthyl-triméthylène carbonate et le 1,3-dioxépan-2-one et leurs mélanges.

85. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 18, dans lequel ledit carbonate est choisi dans le groupe comprenant le triméthylène carbonate, le 5-alkyl-1,3-dioxan-2-one, le 5,5-dialkyl-1,3-dioxan-2-one ou le 5-alkyl-5-alkyloxycarbonyl-1,3-dioxan-2-one, les éthylène-carbonates, le 3-éthyl-3-hydroxyméthyle, le propylène carbonate, le triméthylolpropane monocarbonate, le 4,6-diméthyl-1,3-propylène carbonate, le 2,2-diméthyl-triméthylène carbonate et le 1,3-dioxépan-2-one et leurs mélanges.

90. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 19, dans lequel ledit carbonate est choisi dans le groupe comprenant le triméthylène carbonate, le 5-alkyl-1,3-dioxan-2-one, le 5,5-dialkyl-1,3-dioxan-2-one ou le 5-alkyl-5-alkyloxycarbonyl-1,3-dioxan-2-one, les éthylène-carbonates, le 3-éthyl-3-hydroxyméthyle, le propylène carbonate, le triméthylolpropane monocarbonate, le 4,6-diméthyl-1,3-propylène carbonate, le 2,2-diméthyl-triméthylène carbonate et le 1,3-dioxépan-2-one et leurs mélanges.

95. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 20, dans lequel ledit carbonate est choisi dans le groupe comprenant le triméthylène carbonate, le 5-alkyl-1,3-dioxan-2-one, le 5,5-dialkyl-1,3-dioxan-2-one ou le 5-alkyl-5-alkyloxycarbonyl-1,3-dioxan-2-one, les éthylène-carbonates, le 3-éthyl-3-hydroxyméthyle, le propylène carbonate, le triméthylolpropane monocarbonate, le 4,6-diméthyl-1,3-propylène carbonate, le 2,2-diméthyl-triméthylène carbonate et le 1,3-dioxépan-2-one et leurs mélanges.

5 ddictions 1 à 14, dans lequel les polymères d'ester cyclique et leurs copolymères résultant de la polymérisation de monomères d'esters cycliques comprennent le poly (L-lactide) ; le poly (D-lactide) ; le poly (D,L-lactide) ; le poly (mésolactide) ; le poly (glycolide) ; le poly (triméthylène carbonate) ; le poly(epsilon-caprolactone) ; le poly(L-lactide co-D,L-lactide) ; le poly(L-lactide co-meso-lactide) ; le poly(L-lactide co-glycolide) ; le poly(L-lactide co-triméthylène carbonate) ; le poly(L-lactide co-epsilon-caprolactone) ; le poly(D,L-lactide co-glycolide) ; le poly(D,L-lactide co-triméthylène carbonate) ; le poly(D,L-lactide co-epsilon-caprolactone) ; le poly(meso-lactide co-glycolide) ; le poly(meso-lactide co-triméthylène carbonate) ; le poly(meso-lactide co-epsilon-caprolactone) ; le poly(glycolide co-epsilon-caprolactone).

10 16. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 15, dans lequel ledit polyester obtenu par polymérisation d'au moins un ester cyclique a une valeur PD de 1,1 à 15, de préférence de 1,3 à 9.

15 17. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 16, dans lequel au moins l'un desdits au moins un élastomère biodégradable comprend ledit polyester produit par réaction d'au moins un alcool ou dérivé de celui-ci et au moins un acide ou dérivé de celui-ci.

20 18. Chewing-gum comprenant au moins deux polymères biodégradables différents selon la revendication 17, dans lequel ledit élastomère est produit par réaction d'au moins un acide choisi parmi les acides téraphthalique, phthalique, adipique, phénolique ou leurs combinaisons avec au moins un alcool choisi parmi les groupes de diols diéthylène et 1,4-butylène ou leurs combinaisons.

25 19. Chewing-gum comprenant au moins deux polymères biodégradables différents selon la revendication 17 ou 18, dans lequel ledit au moins un élastomère biodégradable produit par réaction d'au moins un alcool ou dérivé de celui-ci et au moins un acide ou dérivé de celui-ci a un poids moléculaire de 10000-250000 g/mole (Mn), de préférence de 20000-150000 g/mole (Mn).

30 20. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 19, dans lequel au moins un desdits plastifiants élastomères biodégradables comprend ledit polyester produit par réaction d'au moins un alcool ou dérivé de celui-ci et au moins un acide ou dérivé de celui-ci.

35 21. Chewing-gum comprenant au moins deux polymères biodégradables différents selon la revendication 20, dans lequel ledit plastifiant élastomère est produit par réaction d'au moins un acide choisi parmi les acides téraphthalique, succinique, malonique et adipique ou leurs combinaisons, avec au moins un alcool choisi parmi les diols éthylène, diéthylène ou 1,4-butylène et leurs combinaisons.

40 22. Chewing-gum comprenant au moins deux polymères biodégradables différents selon la revendication 20 ou 21, dans lequel au moins un desdits plastifiants élastomères biodégradables produit par réaction d'au moins un alcool ou dérivé de celui-ci et au moins un acide ou dérivé de celui-ci a un poids moléculaire de 500 à 19000 g/mole (Mn), de préférence de 1500 à 9000 g/mole (Mn).

45 23. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 22, dans lequel au moins l'un desdits élastomères biodégradables comprend ledit polyester obtenu par polymérisation d'au moins un ester cyclique.

50 24. Chewing-gum comprenant au moins deux polymères biodégradables différents selon la revendication 23, dans lequel le poids moléculaire dudit élastomère biodégradable comprenant au moins l'un desdits polyesters obtenus par polymérisation d'au moins un ester cyclique est de l'ordre de 10000 à 1000000 g/mole (Mn), de préférence de l'ordre de 30000 à 250000 g/mole (Mn).

55 25. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 24, dans lequel au moins l'un desdits plastifiants élastomères biodégradables comprend ledit polyester obtenu par polymérisation d'au moins un ester cyclique.

26. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 25, dans lequel ledit chewing-gum comprend au moins un plastifiant élastomère comprenant au moins l'un desdits polyesters obtenus par polymérisation d'au moins un ester cyclique et au moins un élastomère comprenant au moins l'un desdits polyesters produits par réaction d'au moins un alcool ou dérivé de celui-ci et au moins

un acide ou dérivé de celui-ci.

27. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 26, dans lequel au moins deux polymères différents sont hydrophiles.

28. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 27, dans lequel la différence en poids moléculaire entre au moins deux polymères différents est d'au moins 1000 g/mole Mn.

29. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 28, dans lequel la différence en poids moléculaire entre au moins deux polymères différents est d'au moins 20000 g/mole, de préférence d'au moins 50000 g/mole Mn.

30. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 29, dans lequel le poids moléculaire dudit plastifiant biodégradable comprend au moins l'un desdits polyesters obtenu par polymérisation d'au moins un ester cyclique de l'ordre de 500 à 19000 g/mole, de préférence de l'ordre de 1500 à 9000 g/mole Mn.

31. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 30, dans lequel au moins lesdits deux polymères biodégradables différents ont une température de transition vitreuse Tg différente.

32. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 31, dans lequel au moins l'un desdits polymères biodégradables utilisés, de préférence un plastifiant, a une température de transition vitreuse d'au moins +1°C, de préférence d'au moins +10°C et de manière davantage préférée, d'au moins +20°C.

33. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 32, dans lequel au moins l'un desdits au moins deux polymères biodégradables différents a une température de transition vitreuse inférieure à 0°C, de préférence inférieures à -30°C et de manière davantage préférée, inférieure à -50°C.

34. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 33, dans lequel le chewing-gum obtenu a au moins deux températures de transition vitreuse Tg différentes.

35. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 34, dans lequel le chewing-gum comprend au moins un élastomère biodégradable ayant une température de transition vitreuse Tg inférieure à 0°C et au moins un plastifiant ayant une température de transition vitreuse Tg dépassant 0°C.

36. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 35, dans lequel ledit chewing-gum comprend au moins un élastomère biodégradable en une quantité de 0,5 à 70 % en poids de chewing-gum, au moins un plastifiant biodégradable en une quantité de 0,5 à 70 % en poids de chewing-gum et au moins un ingrédient de chewing-gum choisi dans les groupes d'assouplissants, d'éducorants, d'agents aromatisants, d'ingrédients actifs et d'agents de remplissage en une quantité de 2 à 80 % en poids de chewing-gum.

37. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 36, dans lequel tous les polymères biodégradables compris dans le chewing-gum comprennent au moins 25 % de préférence au moins 50 % de polymères de chewing-gum.

38. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 37, dans lequel tous les polymères biodégradables compris dans le chewing-gum comprennent au moins 80 %, de préférence au moins 90 % des polymères de chewing-gum.

39. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 38, dans lequel le chewing-gum est实质iellement dépourvu de polymères non biodégradables.

40. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 39, dans lequel lesdits ingrédients de chewing-gum comprennent des agents aromatisants.

5 41. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 40, dans lequel ledit chewing-gum comprend un arôme en une quantité de 0,01 à 30 % en poids, ledit pourcentage étant basé sur le poids total de chewing-gum, de préférence de 0,2 à 4 % en poids, ledit pourcentage étant basé sur le poids total de chewing-gum.

10 42. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 41, dans lequel lesdits ingrédients de chewing-gum comprennent des édulcorants.

15 43. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 42, dans lequel le chewing-gum comprend des édulcorants en vrac en une quantité de 5 à 95 % en poids de chewing-gum, plus généralement, 20 à 80 % en poids de chewing-gum.

44. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 43, dans lequel le chewing-gum comprend des édulcorants de haute intensité en une quantité de 0 à 3 % en poids de chewing-gum, plus généralement, 0,05 à 0,5 % en poids de chewing-gum.

20 45. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 44, dans lequel le chewing-gum comprend au moins un édulcorant en une quantité de 0 à 18 % en poids de chewing-gum, plus généralement de 0 à 12 % en poids de chewing-gum.

46. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 45, dans lequel lesdits ingrédients de chewing-gum comprennent des ingrédients actifs.

25 47. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 46, dans lequel le chewing-gum comprend un agent de remplissage en une quantité de 0 à 50 % en poids de chewing-gum, de préférence de 10 à 40 % en poids de chewing-gum.

30 48. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 47, dans lequel ledit chewing-gum comprend au moins un agent colorant.

49. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 48, dans lequel le chewing-gum est enrobé d'un enrobage extérieur.

50. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 49, dans lequel ledit chewing-gum comprend au moins un élastomère comprenant au moins l'un desdits polyesters obtenus par polymérisation d'au moins un ester cyclique et au moins un plastifiant élastomère comprenant au moins l'un desdits polyesters produits par réaction d'au moins un alcool ou dérivé de celui-ci et au moins un acide ou dérivé de celui-ci.

51. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 50, dans lequel ledit chewing-gum est dépourvu de cire.

45 52. Chewing-gum comprenant au moins deux polymères biodégradables différents selon l'une quelconque des revendications 1 à 50, dans lequel ledit chewing-gum comprend une cire.

53. Chewing-gum selon l'une quelconque des revendications 1 à 39, dans lequel le chewing-gum est une base de gomme.

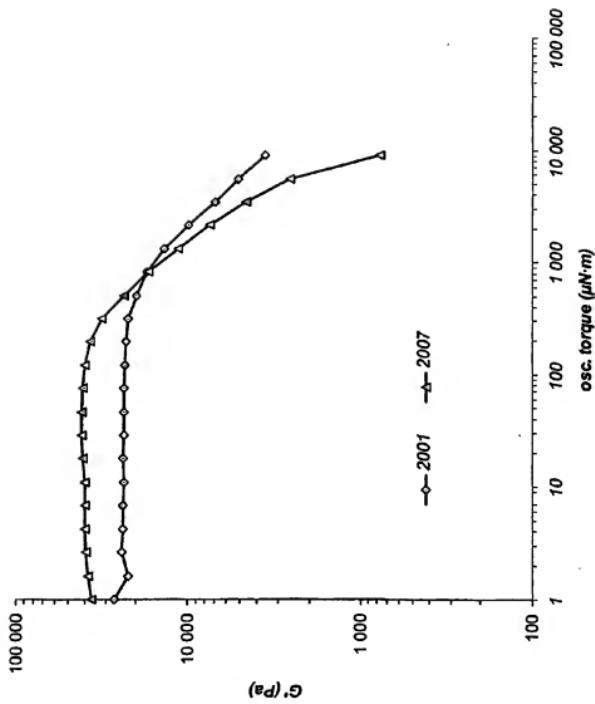


Fig. 1

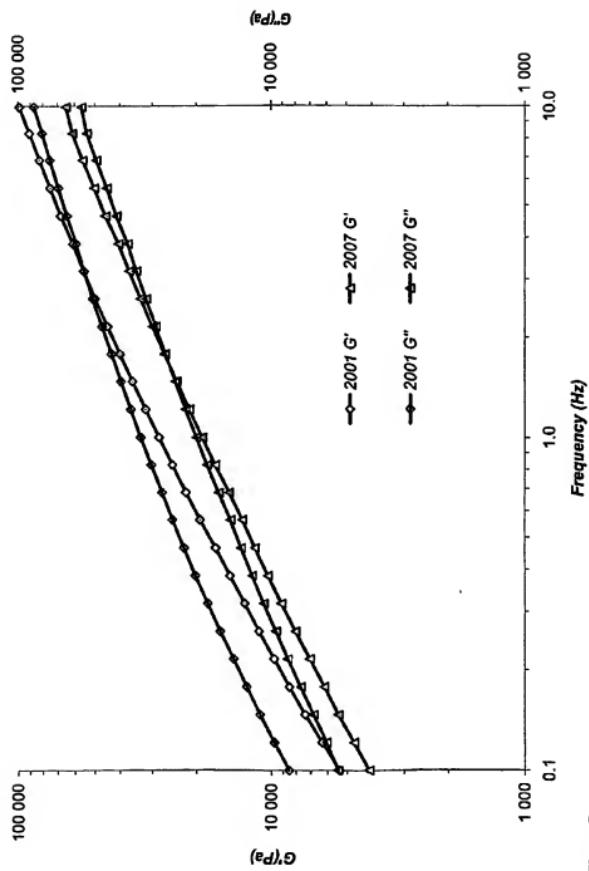
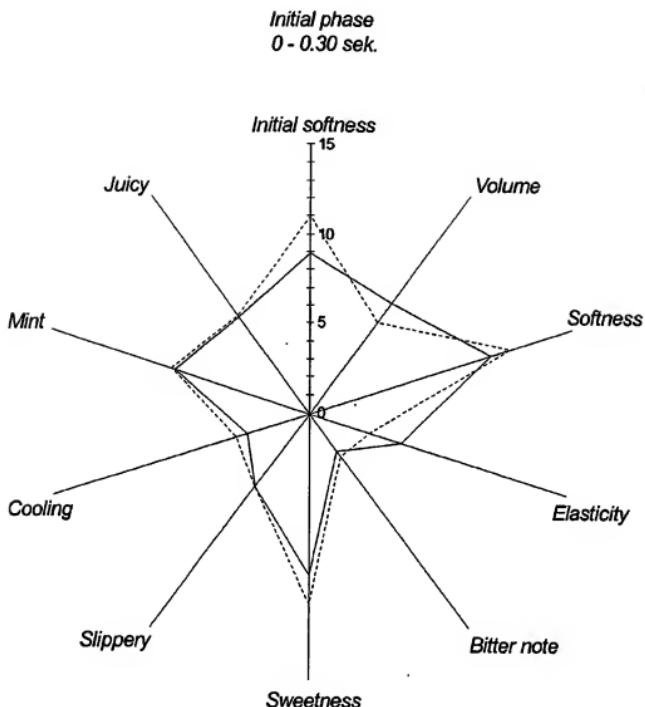


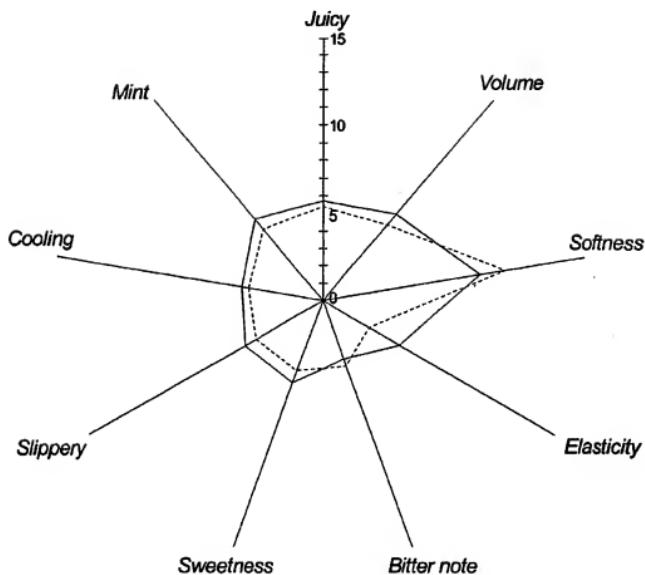
Fig. 2



2001 = -----  
2007 = -----

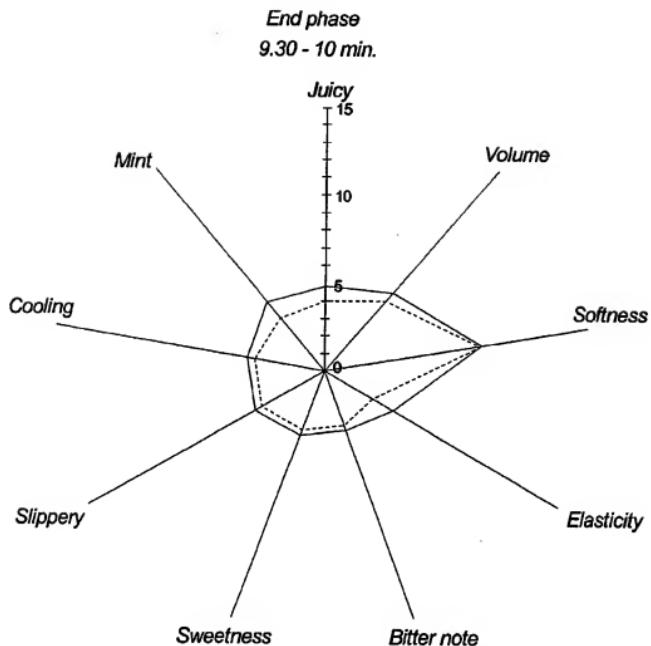
Fig. 3

*Intermediate phase*  
4.30 - 5 min.



2001 = .....  
2007 = \_\_\_\_\_

*Fig. 4*



2001 = -----  
2007 = -----

Fig. 5

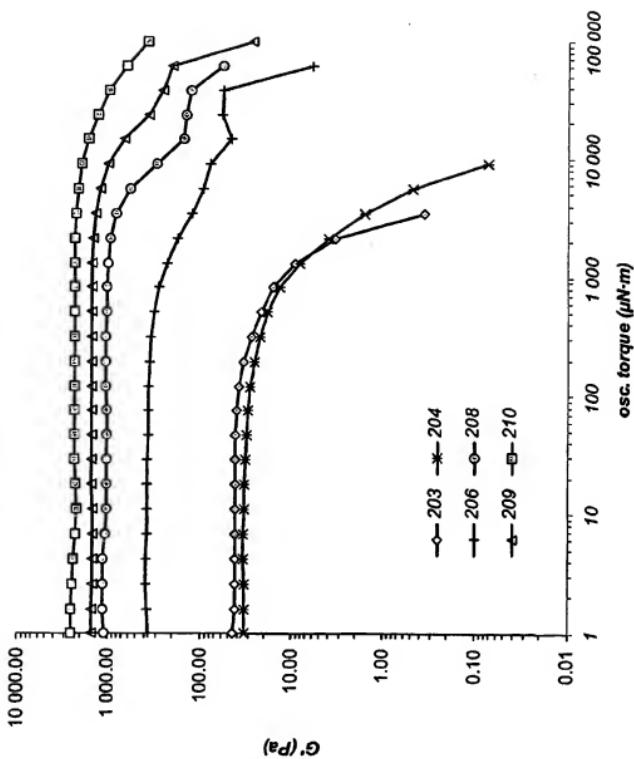


Fig. 6

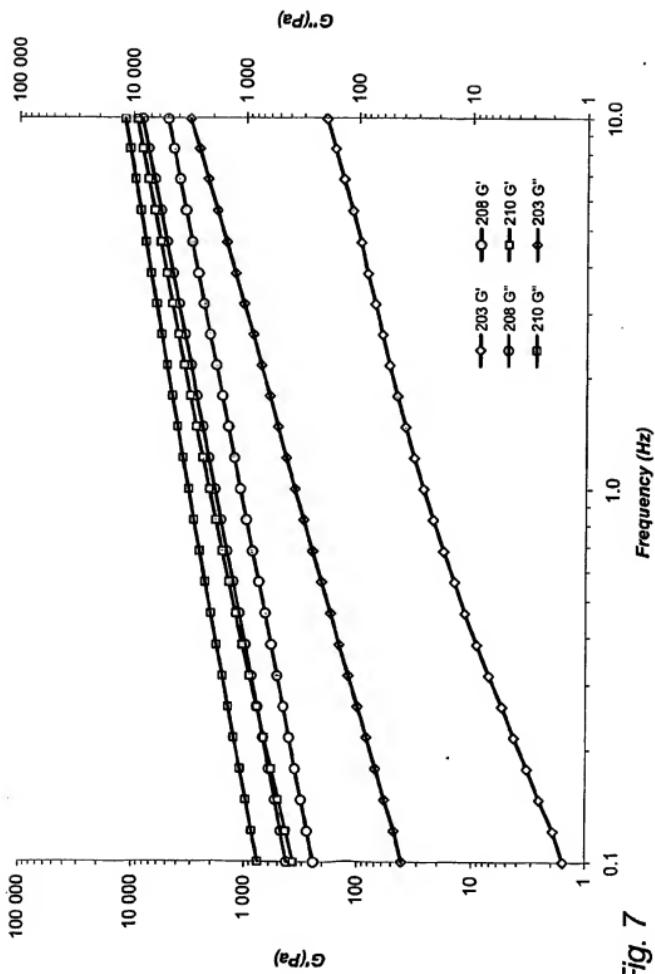


Fig. 7

## REFERENCES CITED IN THE DESCRIPTION

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